

LEGO DACTA®

# Control System

Integrating Math and Science for Upper Elementary

## Setup Guide

Grades 4 & 5  
Beginning  
Computer  
Control  
9702  
BOOK 1

 **da**cta®

The *educational* division of The LEGO® Group



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LEGO DACTA® Control System Setup Guide

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## ► Registration - Do This First!

Please fill out the enclosed customer registration card now and mail it in. By returning the card, your software license will be acknowledged by LEGO Dacta and you will receive information about enhancements to the LEGO DACTA system.

Please make sure you are acquainted with some fundamental aspects of your Macintosh® or MS-DOS® computer before proceeding.

You should be familiar with these computer components:

- Keyboard
- Monitor screen
- Disk drive
- Floppy disk
- Mouse
- Printer

You should know how to do the following using a mouse:

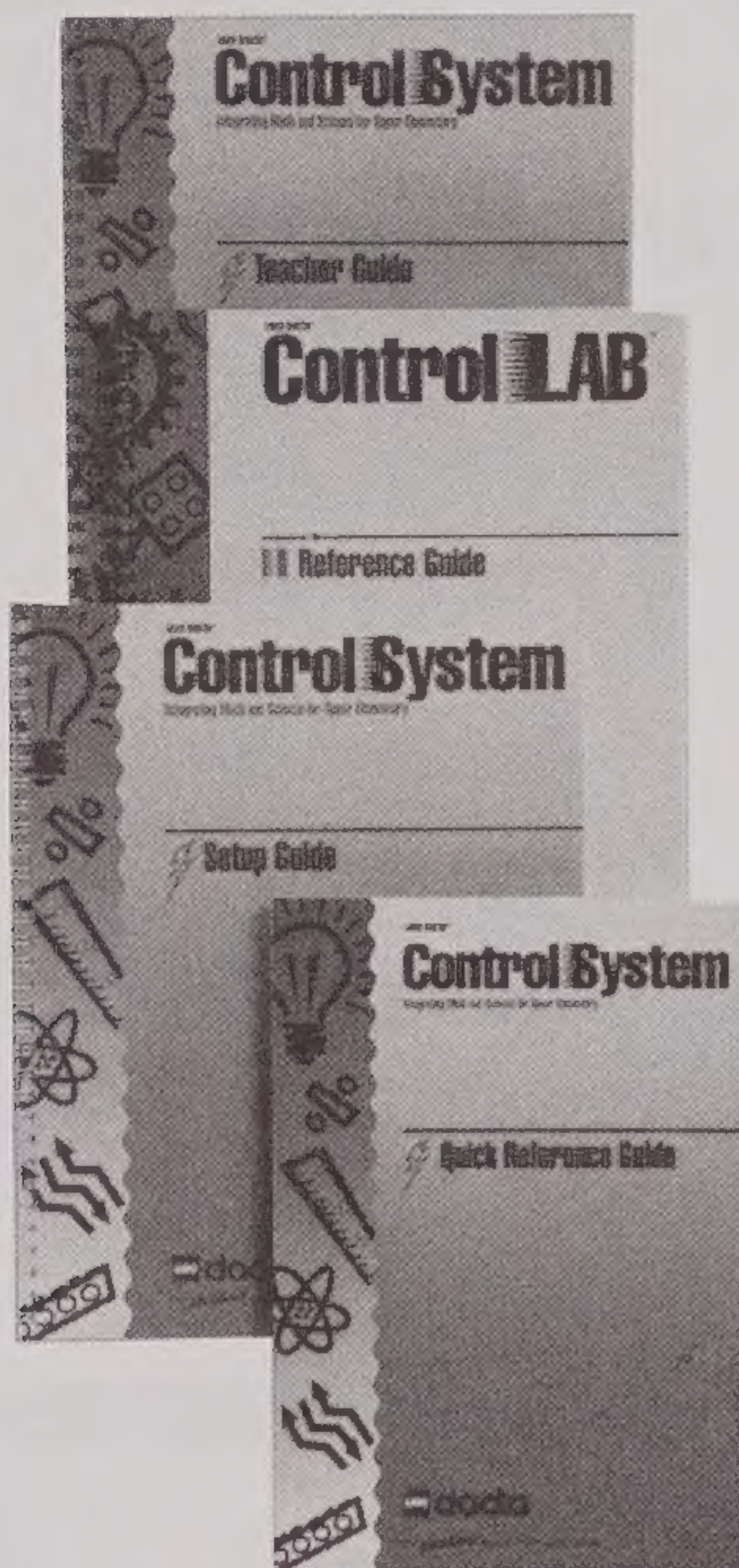
- **Point** to an object
- **Click** on an object to select it
- **Drag** a selected object to a new location or select from a menu
- **Double click** on an object
- **Shift click** on an object

If you are not familiar with these mouse actions, please consult your Macintosh or MS-DOS computer manuals before proceeding.



## System Overview

You should have these components on hand to set up LEGO DACTA® Control System.



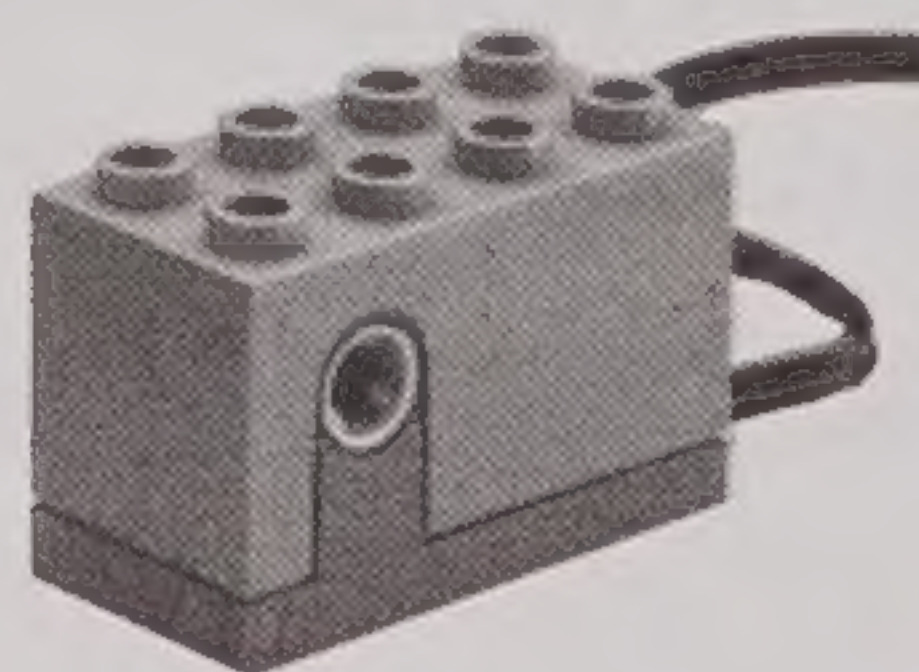
LEGO DACTA  
Control System  
Literature Pack  
Item #978



Light Sensor  
Item #9890



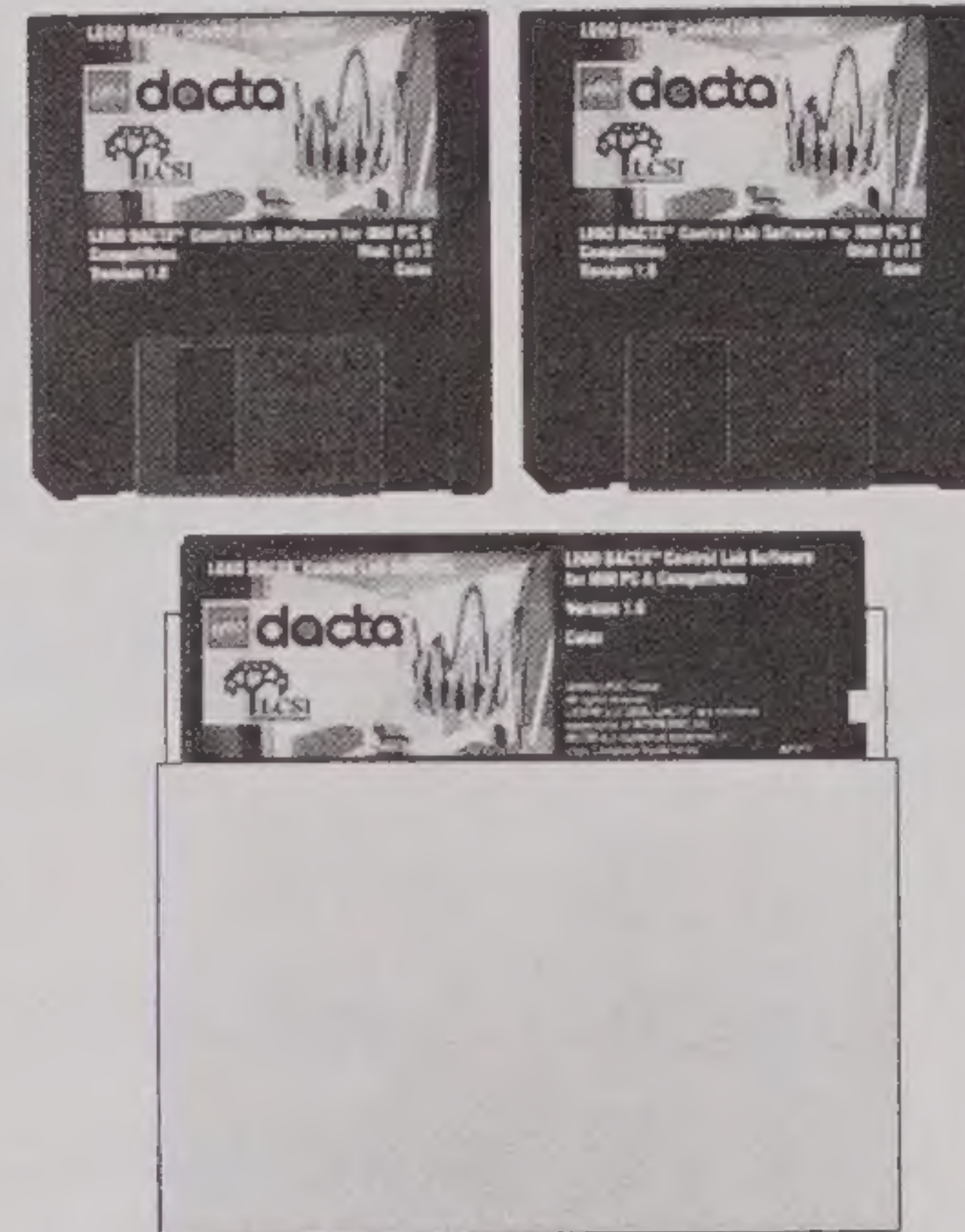
Simple Control  
Building Set  
Item #9702



Angle Sensor  
Item #9891



Control Lab  
Software  
Item #066 or  
#068 for  
Macintosh



Control Lab Software  
Item #067 or #065 for  
MS-DOS



LEGO DACTA  
Serial Interface  
Item #9751



Interface Cable  
Item #9769 for Macintosh



Interface Cable with Adapter  
Item #9768 for MS-DOS

You should also have a Macintosh or MS-DOS computer which meets the following minimum requirements.

### Teacher note:

Inspect the Control System materials to make sure they are in good condition. If you detect any apparent damage, call Consumer Affairs, LEGO Systems, Inc. for service at 203-763-3211. The interface and transformer are covered by a limited one-year warranty which is included in the carton. Please read the warranty carefully.

### Macintosh

- 1 megabyte (MB) RAM
- System 6.0 or higher
- Finder 6.0 or higher
- 1 serial modem or printer port available
- Color or monochrome monitor
- Hard disk
- To load the color version, you must have a **high density** 3.5" disk drive

### MS-DOS

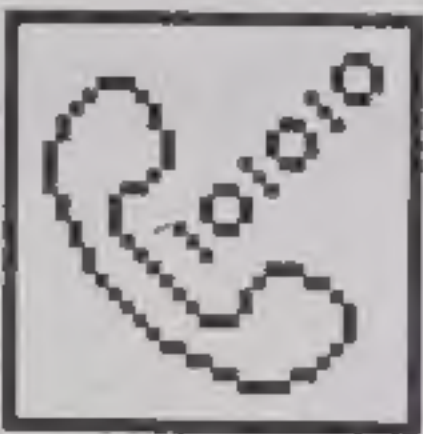
- 640 kilobytes (K) RAM
- DOS version 3.1 or higher
- Mouse
- Mouse driver 6.24 or higher (Microsoft® standard)
- 1 serial port (in addition to mouse port)
- EGA color or monochrome monitor
- Hard disk
- A 3.5" disk drive or a **high density** 5.25" disk drive



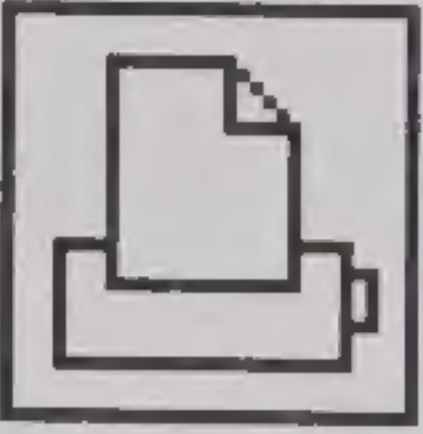
# Install the LEGO DACTA® Serial Interface, Transformer, and Cable

## Macintosh note:

Plug the interface box cable into the modem port if it is available.



Otherwise, use the printer port. (See page 31.)



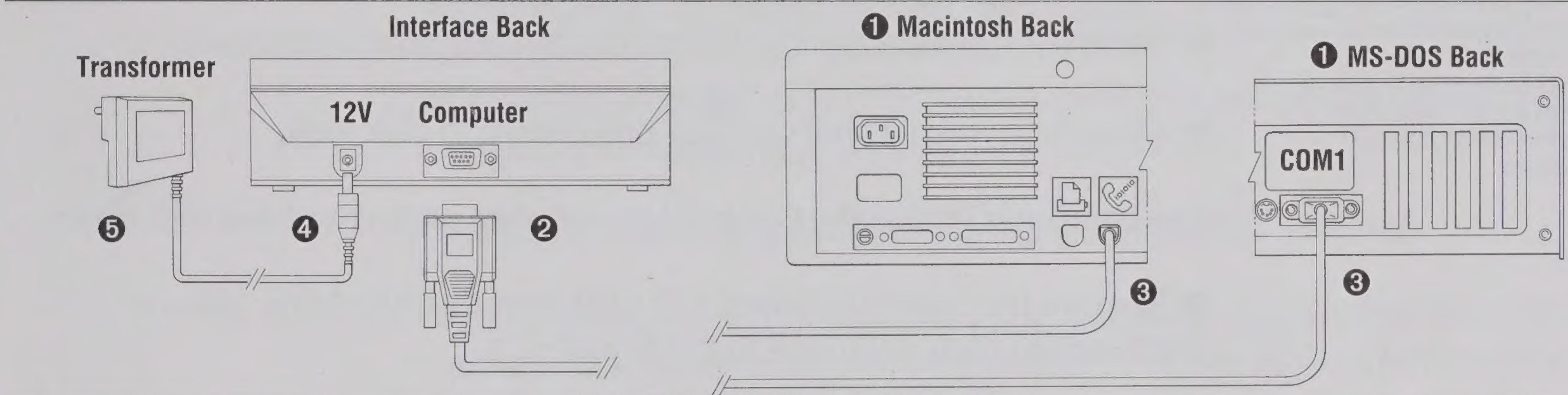
## MS-DOS note:

If the serial port on the MS-DOS computer is a 25-pin port use the pin converter furnished. Plug it onto the end of the cable with nine holes.

- ▶ 1. Turn off the computer.

Identify the end of the cable with nine pins protruding: a row of five and a row of four.

- ▶ 2. Connect the cable to the interface box.
- ▶ 3. Connect the other end of the cable to the computer.
- ▶ 4. Connect the transformer cord to the interface box.
- ▶ 5. Plug the transformer into an electrical power socket.



The small green indicator light next to the word On over the black test port should light up. This shows that the interface box is receiving electrical power. The red light over the Stop button also lights up because the software is not yet running.

If the green indicator light is not on, check the transformer to make sure it is plugged in properly and that electrical power is being delivered to the socket into which the transformer is plugged.

## Prepare the Building Set

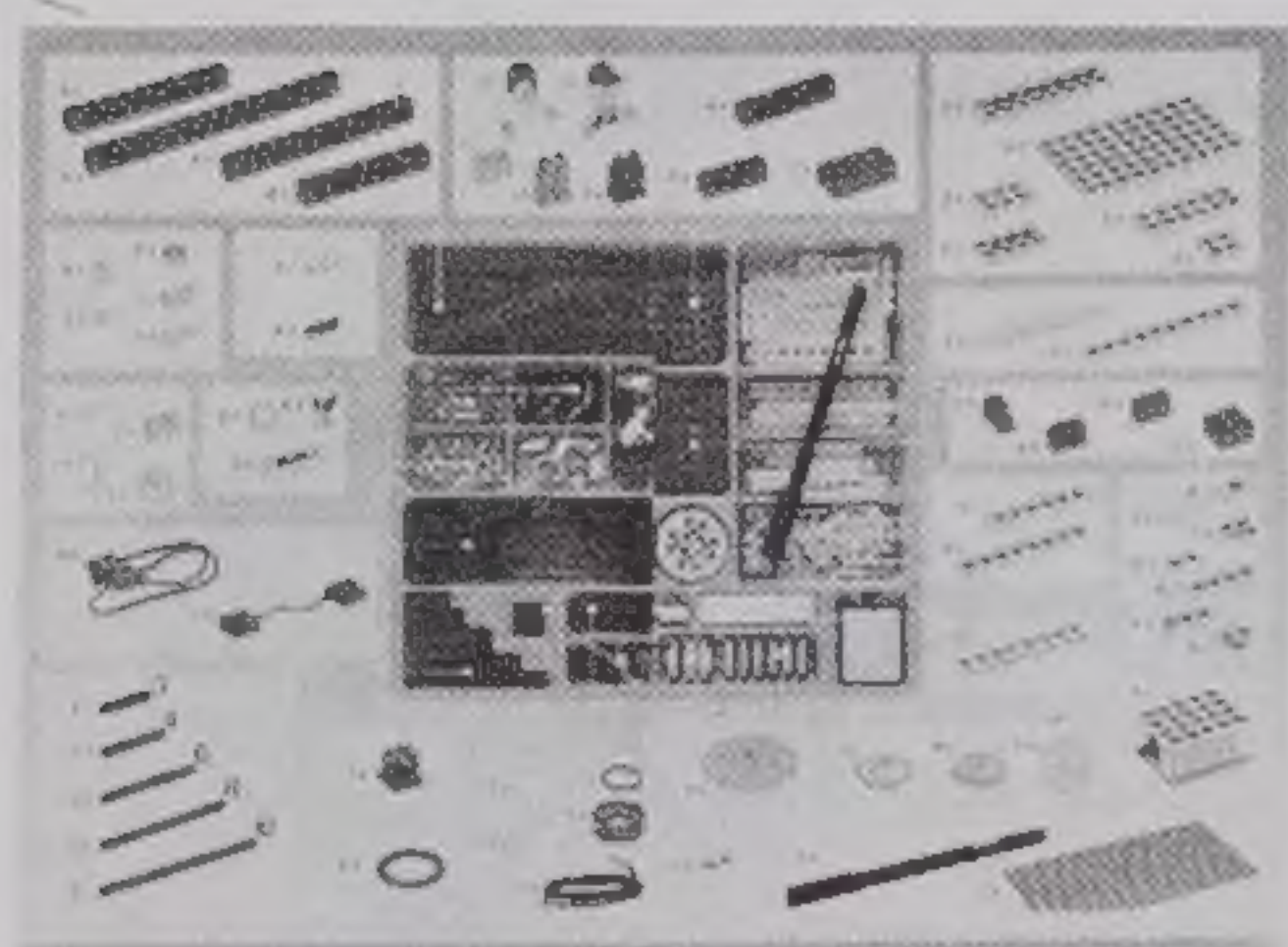
- ▶ Open the LEGO DACTA Simple Control building set (item #9702). When new, the set includes several small bags of building elements and a pack of five large blue booklets containing building instructions. (The booklets are often packed beneath the blue storage tray.)

- ▶ Open the light blue booklet to the first full page spread.

- ▶ Place the building elements in the storage tray as shown. "4x" next to a building element means there should be four of that element in the set. Axle lengths are measured in **studs** — the bumps on top of the bricks. The bold faced numbers next to the axles indicate how many studs long the axles are.

## Teacher note:

If the green light still does not turn on, call LEGO DACTA at 800-527-8339 and ask for technical support.



## Teacher note:

At the end of each building session, you may wish to have students use the light blue booklet for assistance in taking inventory and storing the building elements.



## Install the LEGO DACTA® Control Lab Software

### Macintosh users:

Control Lab software is shipped on two disks: one 3.5" black and white version and one 3.5" color version. Use the black and white version with Macintosh Plus, SE, SE/30, Classic, and Classic II computers. Use the color version on all other Macintosh models, even if a monochrome monitor is used.

### Macintosh users:

You may wish to create a Control System folder on your hard disk for the Control Lab software and student project files. See your Macintosh manual for details.

### MS-DOS users:

Control Lab software is shipped on two 3.5" double density disks or one 5.25" high density disk. Choose the appropriate size for your computer. If you use the 3.5" disks, remember to copy files from both disks.

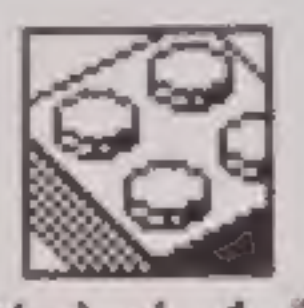
It is possible to run Control Lab from the 3.5" or 5.25" high density disk drive of an MS-DOS computer system but it is not recommended because of the system speed and memory demands.

Follow the instructions below to install the Control Lab software on a hard disk.

- ▶ Start the computer.
- ▶ Read the margin notes and select the appropriate floppy disk.
- ▶ Insert the Control Lab floppy disk in the disk drive. Follow the appropriate instructions below to complete the software installation.

### Macintosh

The Control Lab disk icon appears on the monitor screen.

- ▶ Open the Control Lab disk by double clicking on the disk icon.
- ▶ Drag the Control Lab icon  onto the hard disk icon.

Ctrlab 1.0

The computer copies the Control Lab software onto your hard disk drive.

- ▶ Remove the original Control Lab disk from the disk drive. This is your backup copy so store it in a safe place.

### MS-DOS

- ▶ At the C> prompt, type `md ctrlab` to create a subdirectory for Control Lab.
- ▶ Next, type `cd ctrlab` to get into the Control Lab subdirectory.
- ▶ Then type `copy a:*. * c:` to copy the Control Lab software into the `ctrlab` directory on the hard disk.

The computer copies the Control Lab software onto your hard disk drive.

- ▶ Optional: Type `a:install` to install the software on your hard drive and follow the prompts. (You may need to type `b:install` instead if you inserted your floppy disk in drive B.)
- ▶ Remove the original Control Lab disk from the disk drive. This is your backup copy so store it in a safe place.

Congratulations! You have set up Control System for use. Now you are prepared to explore how the system components work.



# Introductory Explorations

The pages that follow contain simple introductory explorations for learning about the various components of the LEGO DACTA® Control System. No previous knowledge of LEGO® components is assumed.

The five explorations require from 30 to 45 minutes each. The pages may be photocopied for both teacher and student use. Students need to read carefully each action statement (marked with ►) and carry it out in sequence.

Students can use copies of the checklists on pages 26 through 30 to track their progress.

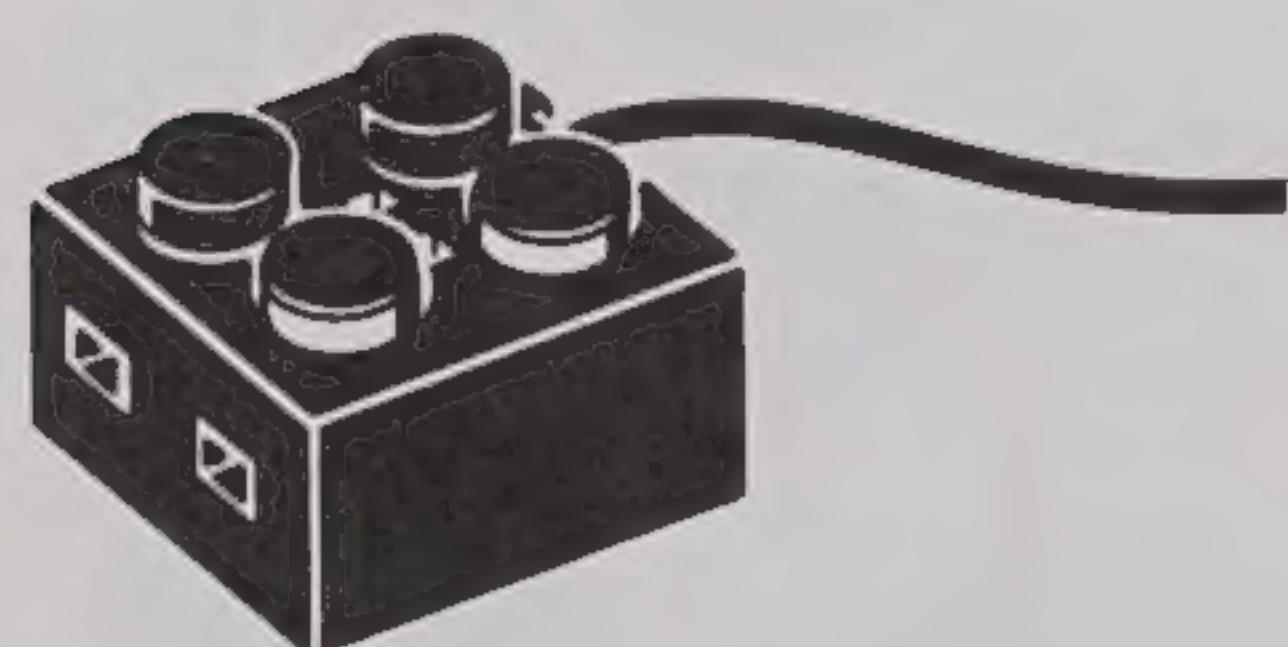
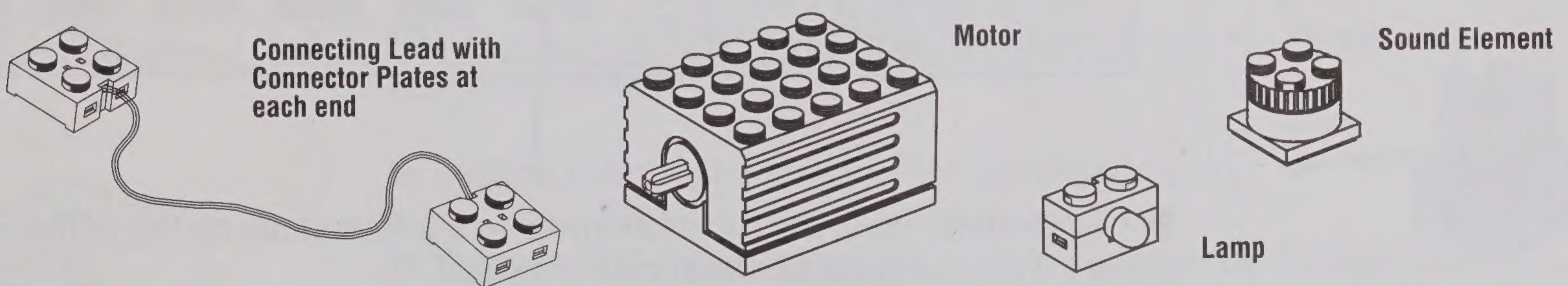
## Exploration 1: Using the Motor, Lamp, and Sound Element

► Make sure the LEGO DACTA Serial Interface is connected to the computer and is being powered by the transformer.

The green indicator light above the test port should be shining.

It is not necessary to turn on your computer or to start up the Control Lab software yet. The red light above the Stop button is shining because the Control Lab software is not running.

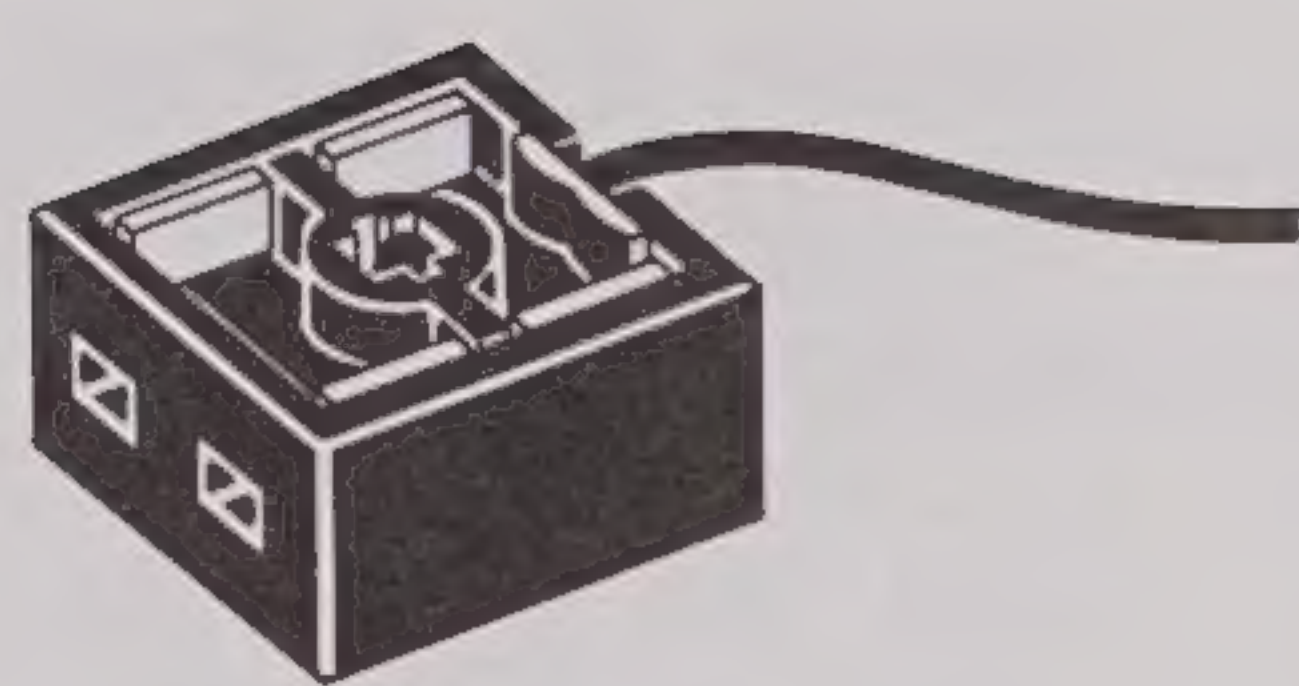
► From the LEGO DACTA Simple Control building set (item #9702), take out one **motor**, one **lamp**, one **sound element** and one **connecting lead**.



Connector Plate Top View

► Pick up the **connector plate** on the end of the connecting lead. Examine the small metal parts in the studs on top of the connector plates at the ends of the wires.





Connector Plate  
Bottom View

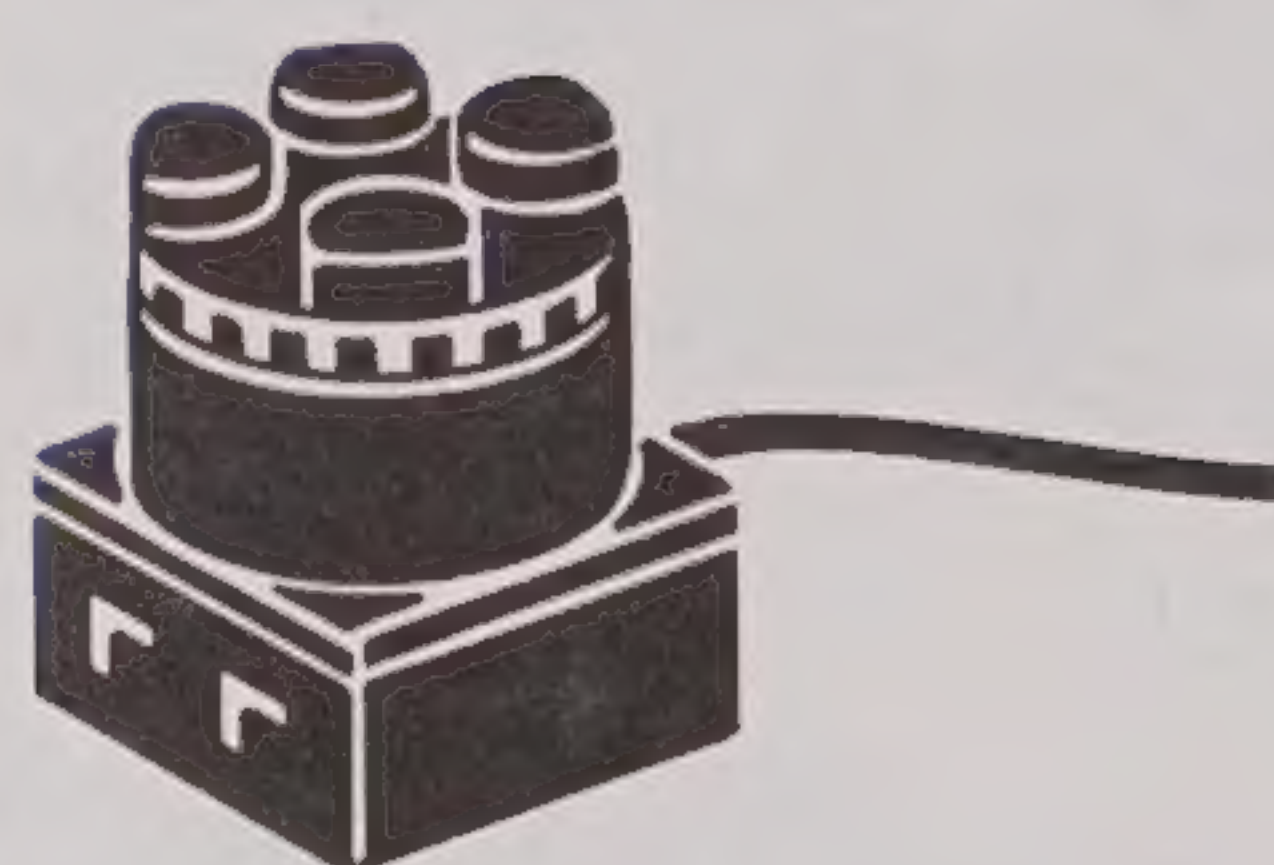
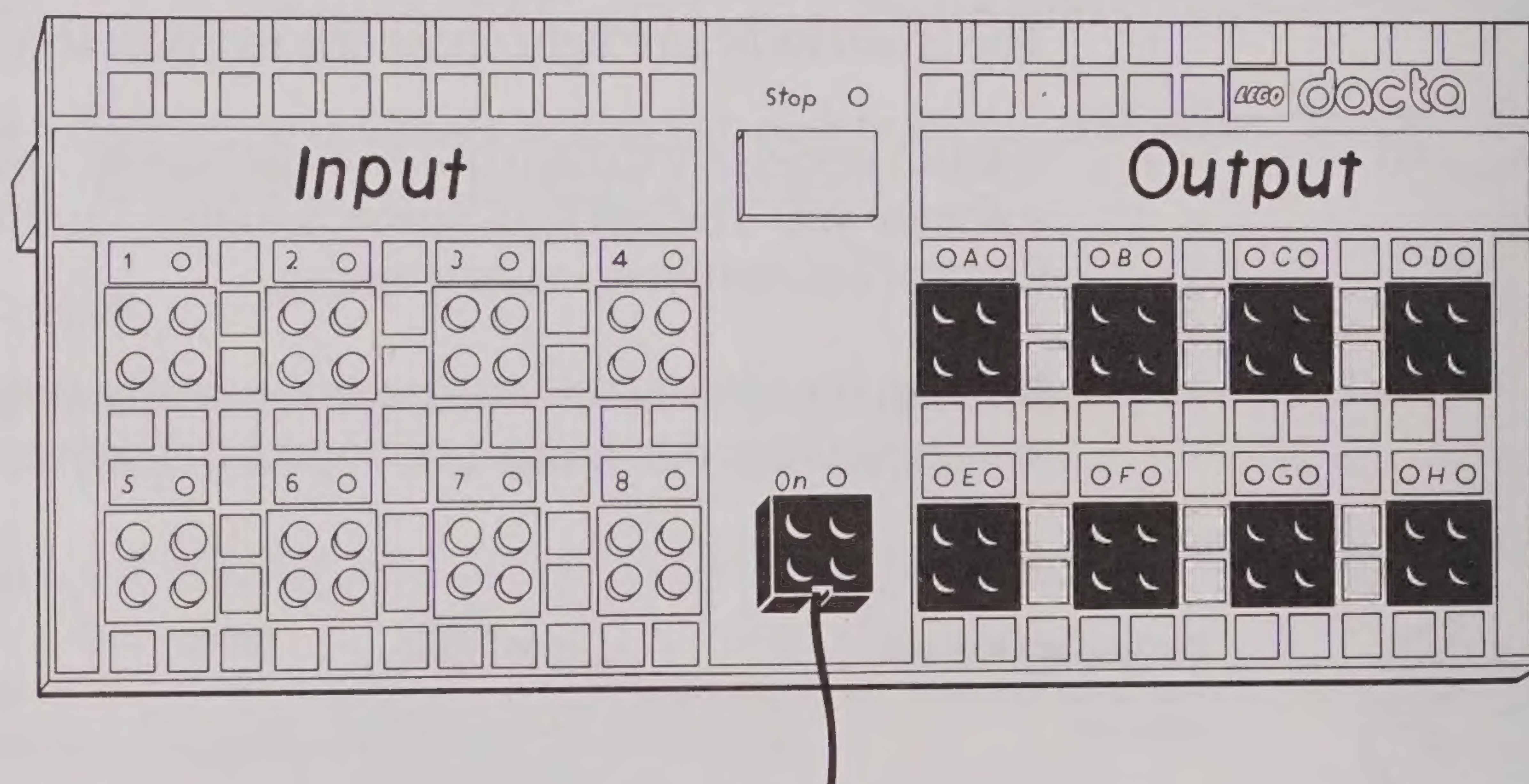
- Examine the metal edges in the recessed bottom of the connector plate.

These metal components provide a pathway for the electricity so it can travel along the wires. This plate is called a 2x2 plate because it has two rows of two studs each.

- Examine the motor, lamp, and sound element. Find the metal components which provide an electrical path through each element.

Note that neither the motor nor the sound element have metal parts in the studs on top.

- Clip the bottom of one connector plate to the test port on the LEGO DACTA® Serial Interface box. Let the connecting lead hang down from the test port toward the bottom of the interface box.

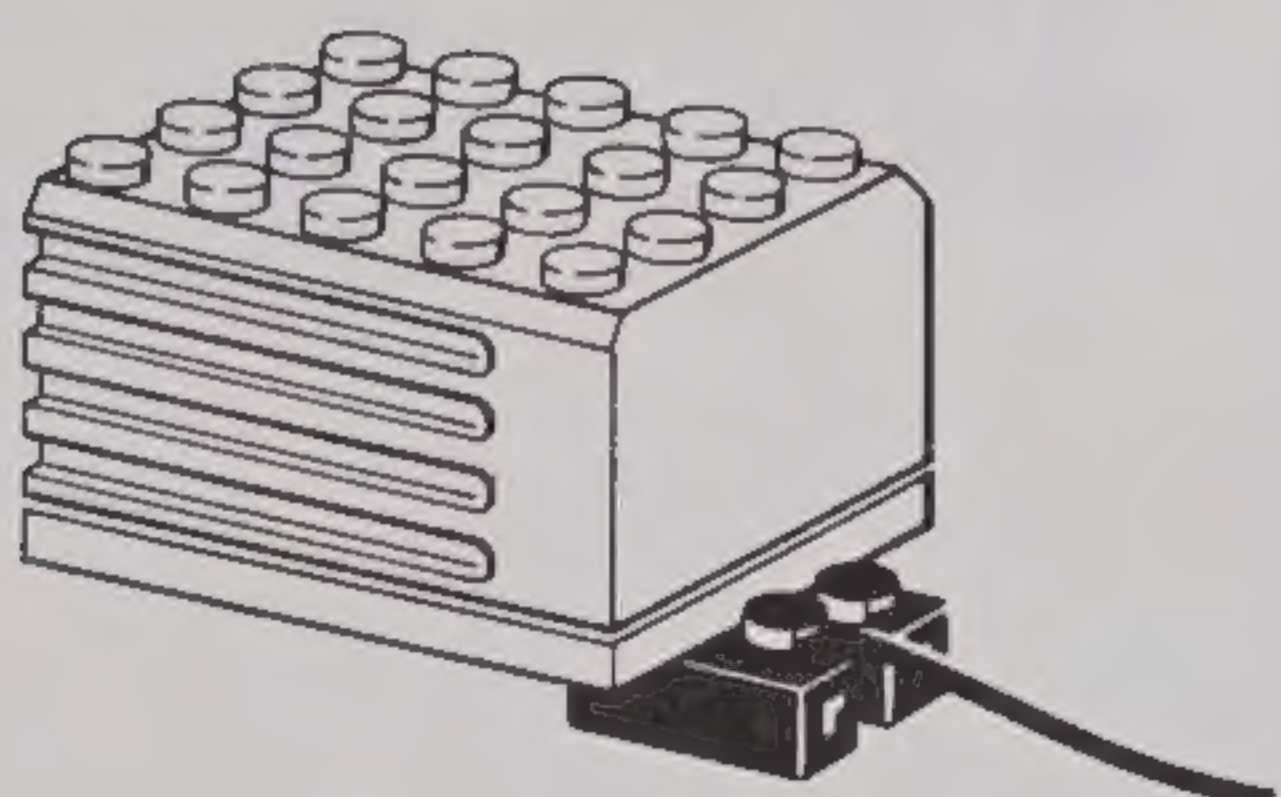
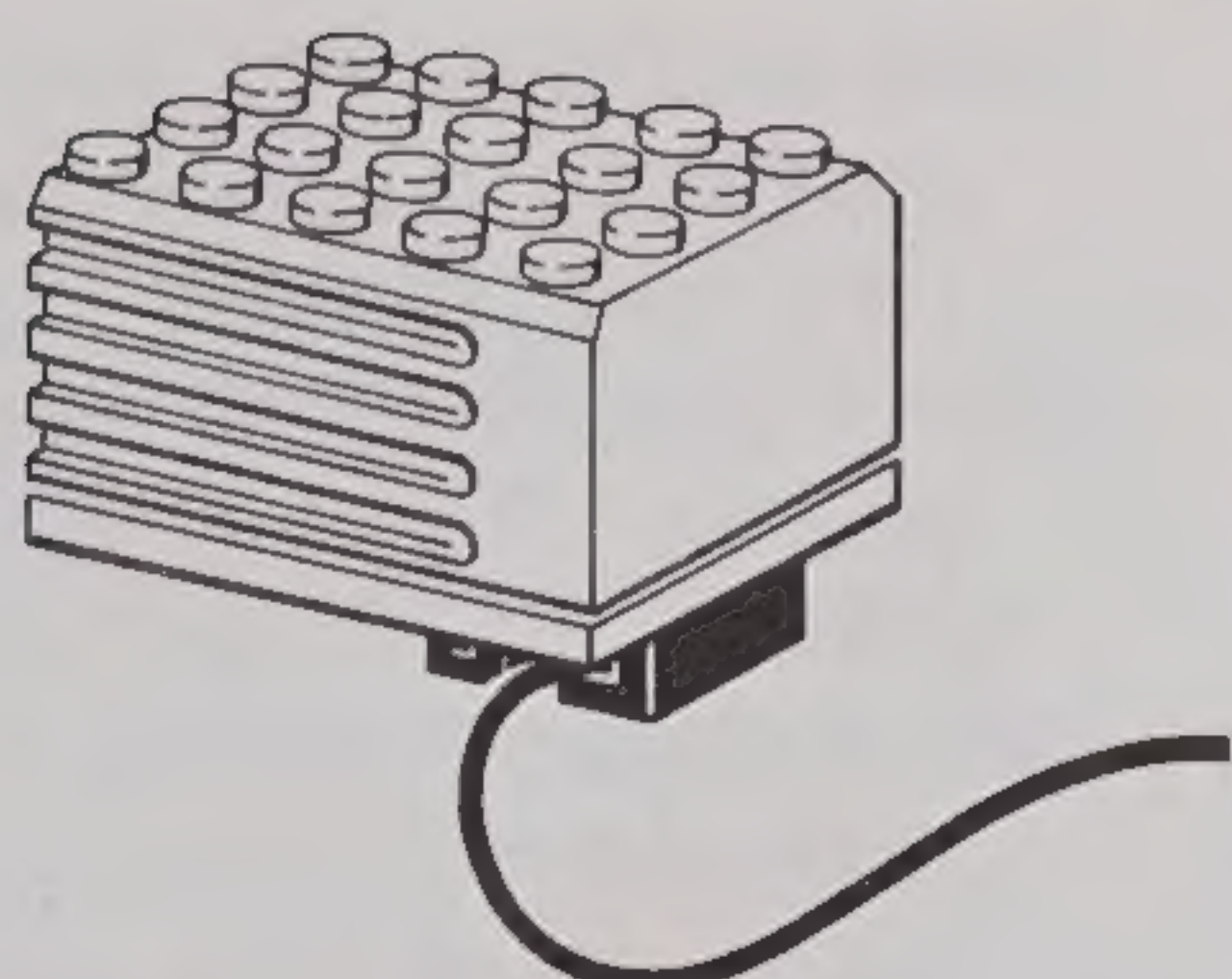
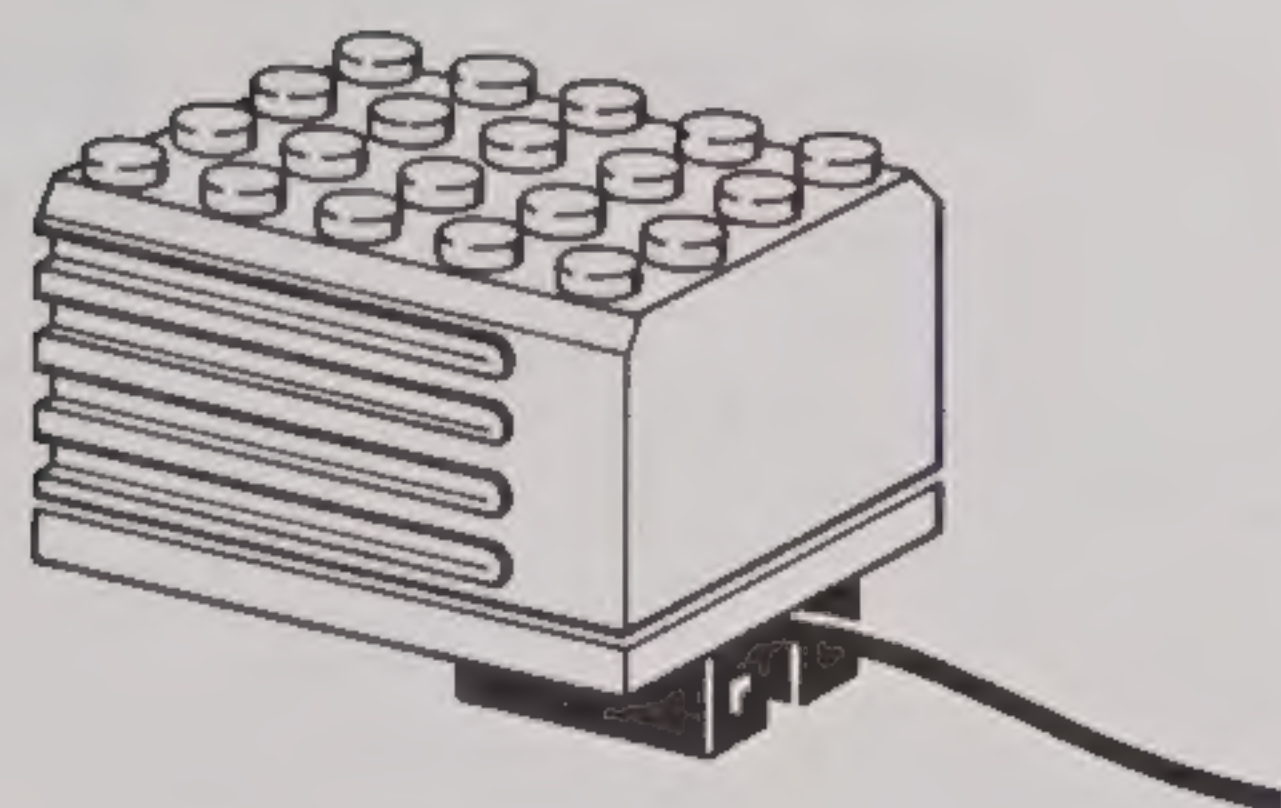
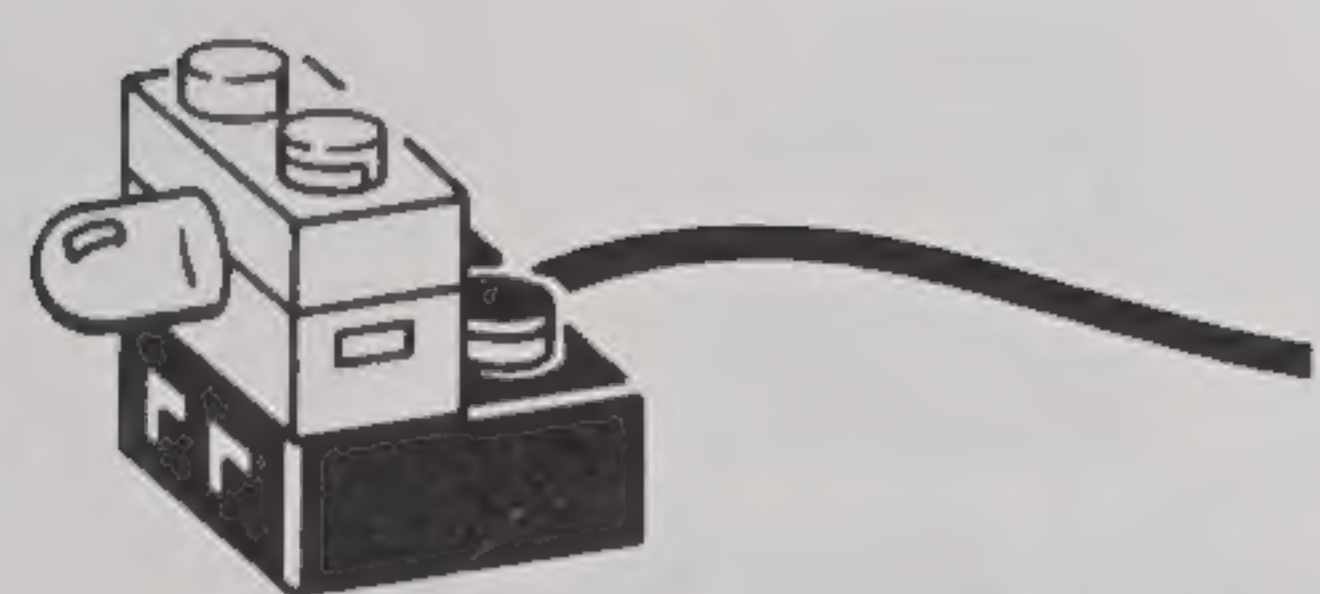


Sound Element on  
Connector Plate

- Clip the bottom of the sound element to the four studs on top of the other connector plate on the connecting lead.
- Grasp the top of the sound element and turn it. Listen to the sound.
- Explore how to control the sound by turning the top of the sound element.

The sound element produces two different sounds, depending on the direction of the electricity current flow. Turning the top of the sound element changes the direction of the electricity. The top has four positions. Two positions stop the flow of electricity and produce no sound. The other two positions produce two different sounds.





Motor Element on  
Connector Plate

► Does the sound element work if it is clipped onto only two of the four studs on the connector plate? \_\_\_\_\_ Be sure to turn the top of the sound element to all four positions.

Yes, the sound element does work when it is connected to the two studs nearest the wire of the connecting lead or to the two studs farthest from the wire of the connecting lead. However, the sound element does not work if it is connected only to two studs on the right or left because the studs on the sides are at the same voltage. In order for electricity to flow, a difference in voltage is needed.

► If the connector plate is fastened to the studs on top of the sound element, is any sound produced? \_\_\_\_\_

No, because there are no metallic studs on top of the sound element.

► Replace the sound element with the lamp. Notice that the lamp lights up when it is clipped to the top or the bottom of the connector plate.

The base of the lamp can be clipped onto the top or bottom of the connector plate. The lamp lights when connected to the two studs nearest the wire or to the two studs farthest from the wire.

► Put the lamp aside and clip the motor to the connector plate.

The connector plate must be clipped to the contact points on the bottom of the motor.

When connected correctly the motor begins to run with a smooth humming sound.

► Explore the possible connection combinations.

► Can you find any connections for which the motor does not run? \_\_\_\_\_

The motor does not run if only two side studs from the connector plate are inserted into the electrical contact points or if the studs from the connector plate are inserted into any nonmetallic LEGO® element.

Also the motor does not run if the connector plate is fastened to the top of the motor since there are no metallic parts there.



- 
- Can you connect both the sound element and the lamp to the end of the connecting lead to produce both light and sound? \_\_\_\_\_  
Can you connect the motor, the lamp and the sound element so that all three are running at once? \_\_\_\_\_

Yes, there are several ways to connect the elements to one lead.

- Disconnect all elements from the connecting lead. Disconnect the connecting lead from the test port.

## Exploration 1 Summary

Now you know how to:

- Attach a connecting lead to the test port.
- Attach a sound element, a lamp and a motor to a connecting lead.



## Exploration 2:

# LEGO DACTA® Control Lab Software - Making Connections

For this exploration, you will need one motor, one lamp, one sound element and three connecting leads from the Simple Control building set (item #9702).

► Make sure the LEGO DACTA Serial Interface, transformer and cable are installed properly. See page 3 for information if necessary.

The green light on the test port should be shining, indicating that the interface box is receiving electrical power. The red light next to the Stop button is shining if you have not started the Control Lab software.

► Turn on the computer.

► Start the Control Lab software.

Control Lab  
icon



CtrlLab 1.0

### Teacher note:

See the Troubleshooting Help section on page 31 if you have difficulty starting the software. If the software still does not load properly, write down any error messages and call LEGO Dacta at 800-527-8339. Ask for technical support.

### Macintosh note:

If you connected the interface to the printer port (see page 3), your software might display a message during the startup process. Click OK. After the software finishes loading, select Preferences from the File menu bar. Click in the button next to the printer port icon in the dialog box.

If you have a Macintosh computer, start up Control Lab by double clicking on the Control Lab icon. For MS-DOS, go to the `ctrlab` subdirectory, then type `ctrlab` and press Enter.

When you see the Control Lab title screen on the monitor, you know that the software is loading successfully.



► Click on the Control Lab title screen and wait until it has changed.



- ▶ Test the LEGO DACTA® Serial Interface by pressing the red Stop button once.

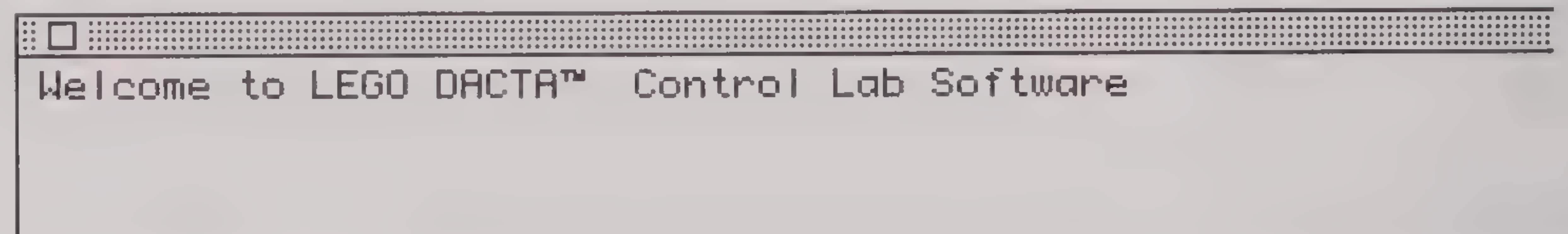
The red light above the button begins flashing on and off if the interface box is functioning properly.

At this point, all electrical power to the black output ports is cut off.

- ▶ Push the Stop button a second time to restore power to the output ports.

The light stops flashing.

- ▶ Locate the **Command Center** on your computer screen; it is the window near the bottom of the screen.

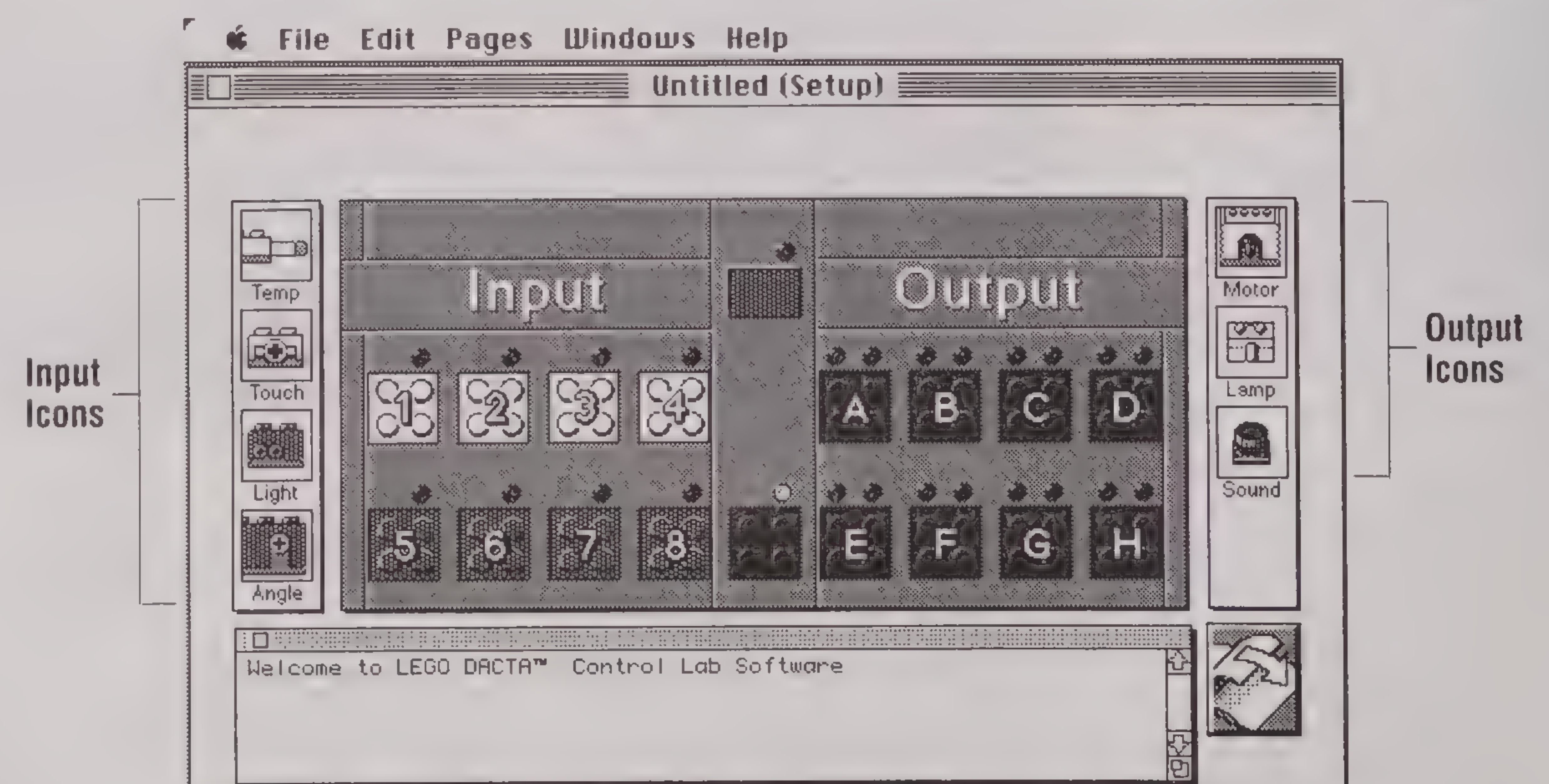
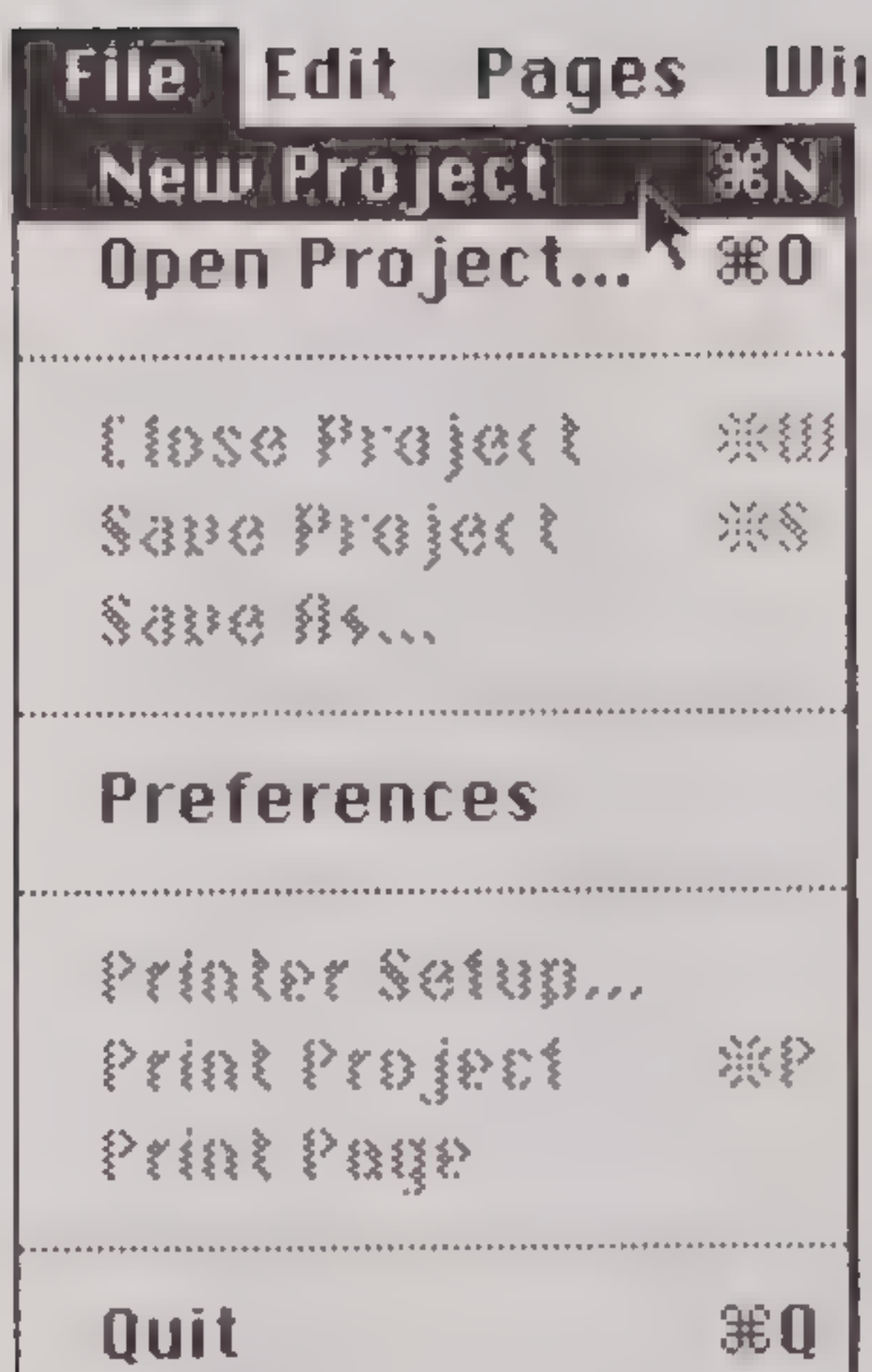


Commands you type in this window are carried out by the computer. Do not type any commands just yet.

- ▶ Click on the File menu and select New Project.

Control Lab files are called **projects**.

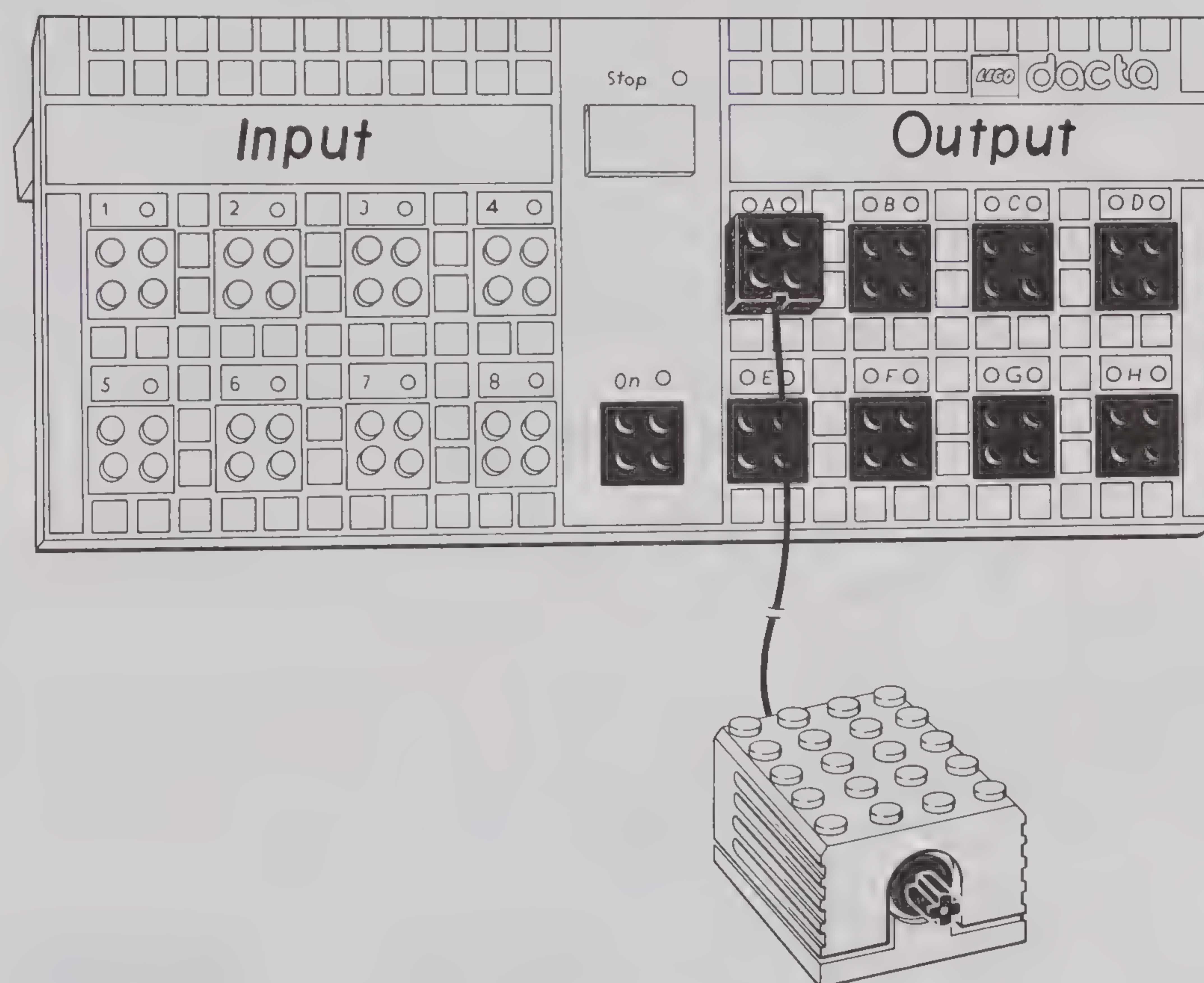
When a new project is created, the first thing you see on the screen is a picture of the interface box. This is the **Setup page**. Note the **output icons** of the motor, lamp, and sound element to the right, and the **input icons** of the various sensors to the left.





► Now look at the LEGO DACTA® Serial Interface itself. Clip one end of a connecting lead to the black output port marked with the letter A, so that the wire hangs down toward the bottom of the box.

► Connect the other end of the connecting lead to a motor.

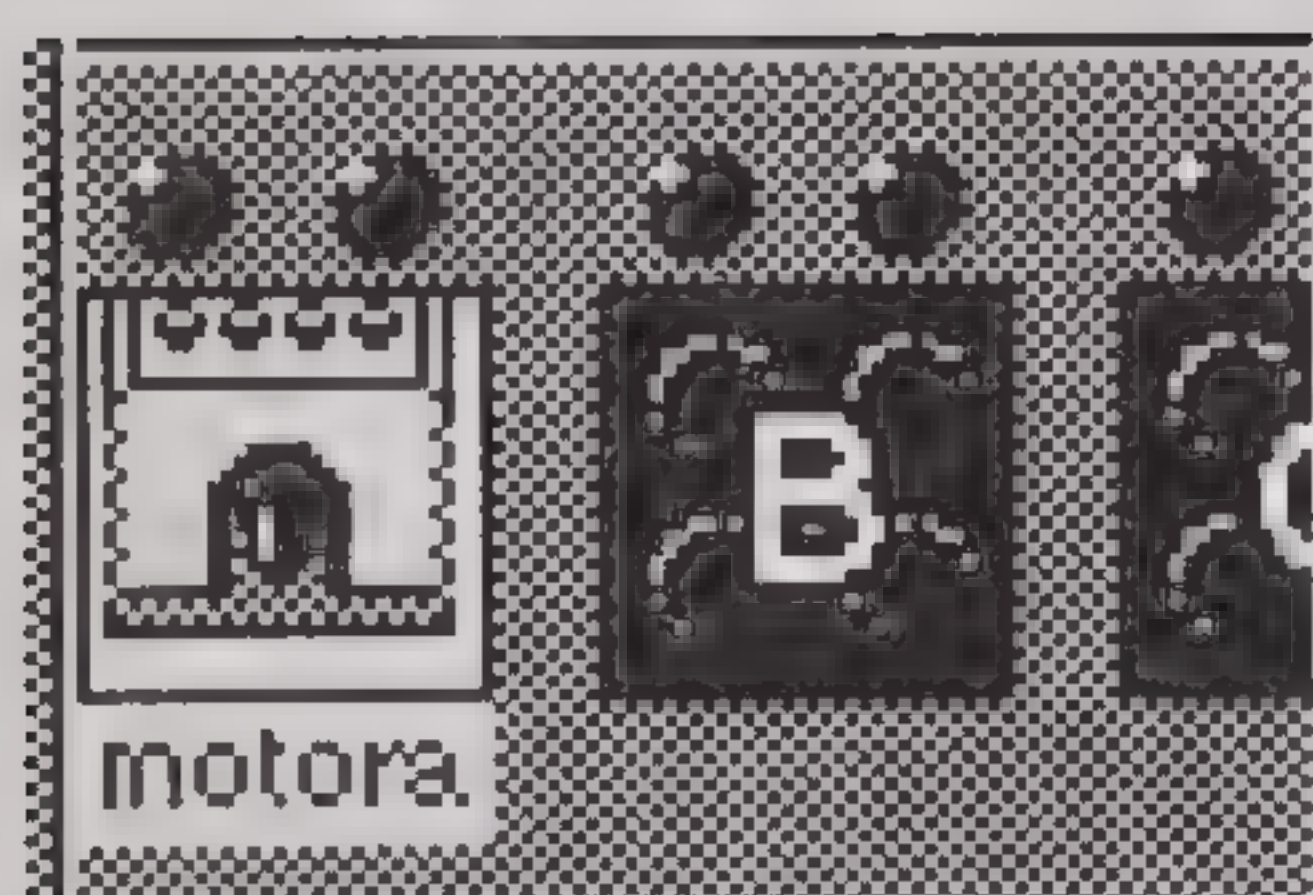


The motor does not run when it is connected to output port A. This is because no electrical power is available at output port A right now. The motor ran when it was connected to the test port because electrical power is always on in that port. Notice that the green indicator light for this port is always on.

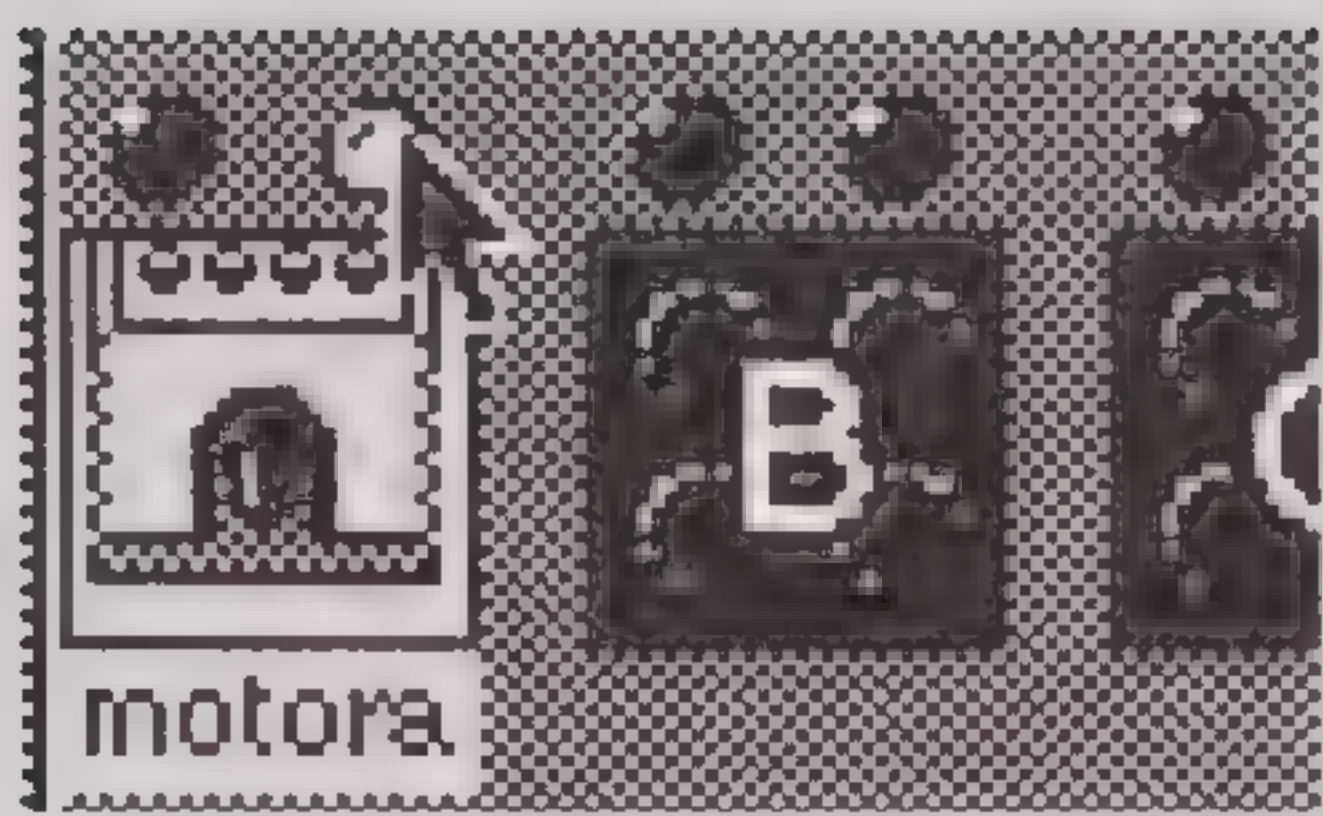
► Select the motor icon with the mouse and drag it to output port A on the Setup page. Release the mouse button.

The motor icon remains on output port A and the name of the motor becomes “motora.” The name “motora” simply means that the software is expecting that a motor is connected to port A on the interface box.

The motor connection you made on the screen corresponds to the actual motor connection you made with the connecting lead.







► Using the mouse, point to one of the two small circles above the **motora** icon on the Setup page. Press down the mouse button. What happens? \_\_\_\_\_

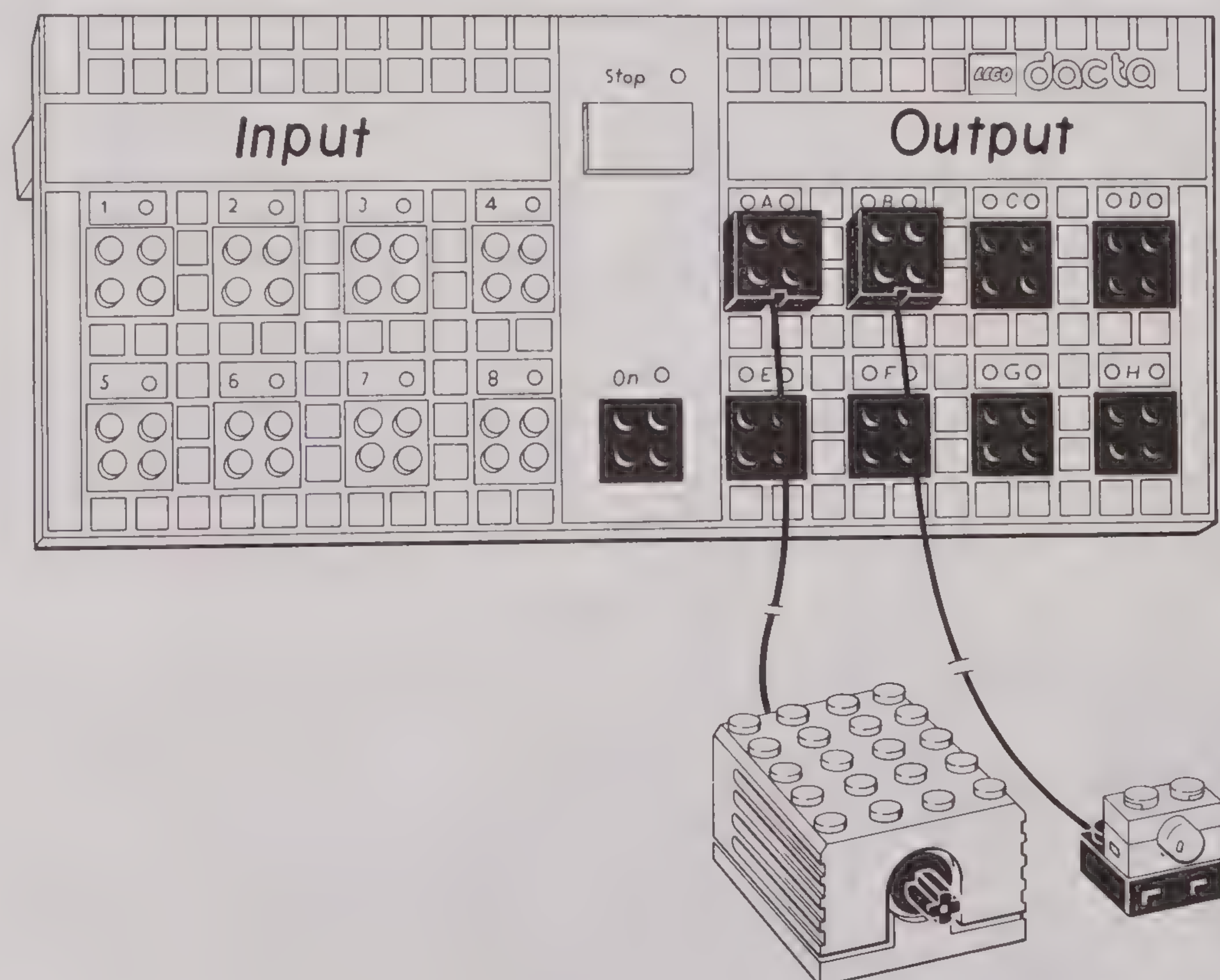
The motor runs as long as you hold down the mouse button.

► Click and hold the pointer in the other circle above port A. What happens? \_\_\_\_\_

The motor runs in the opposite direction.

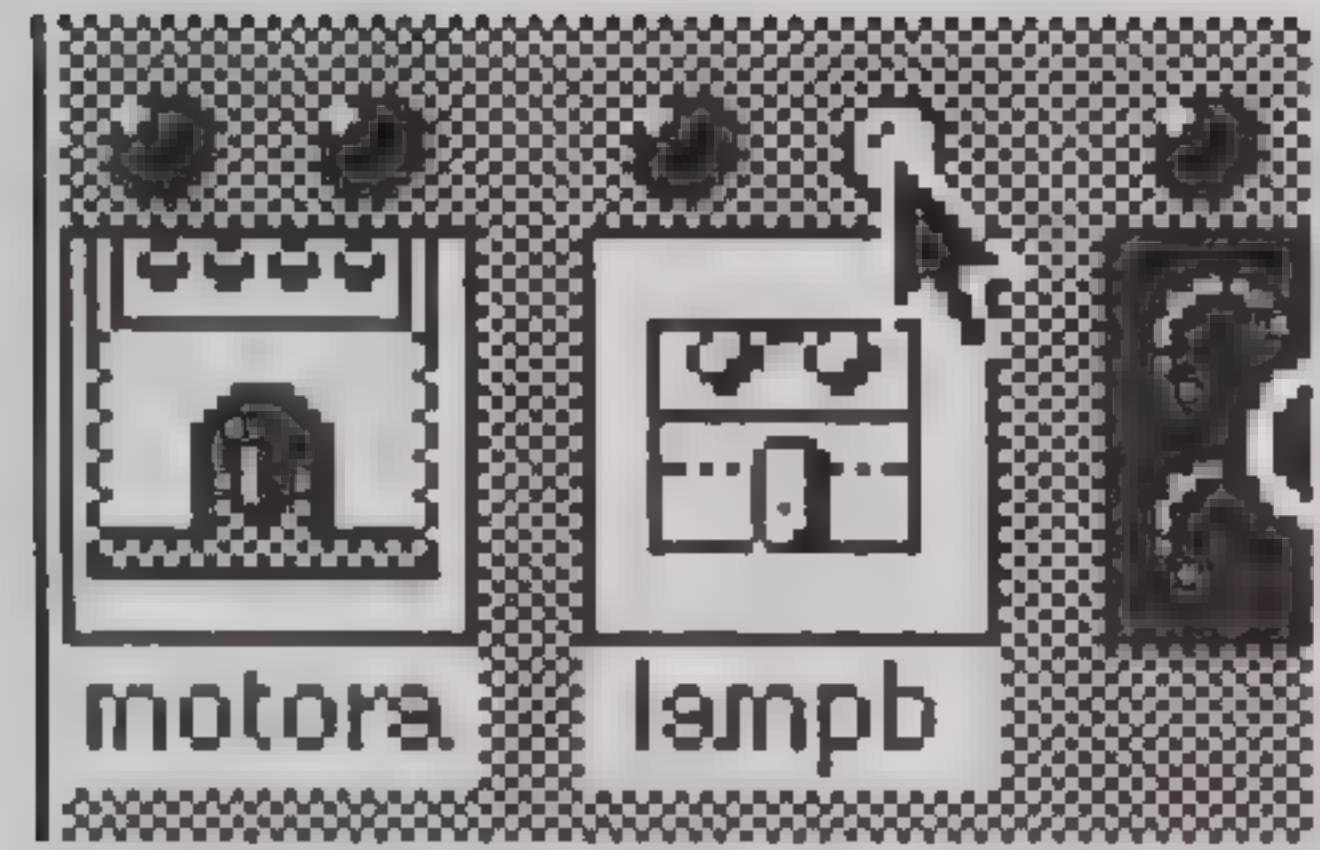
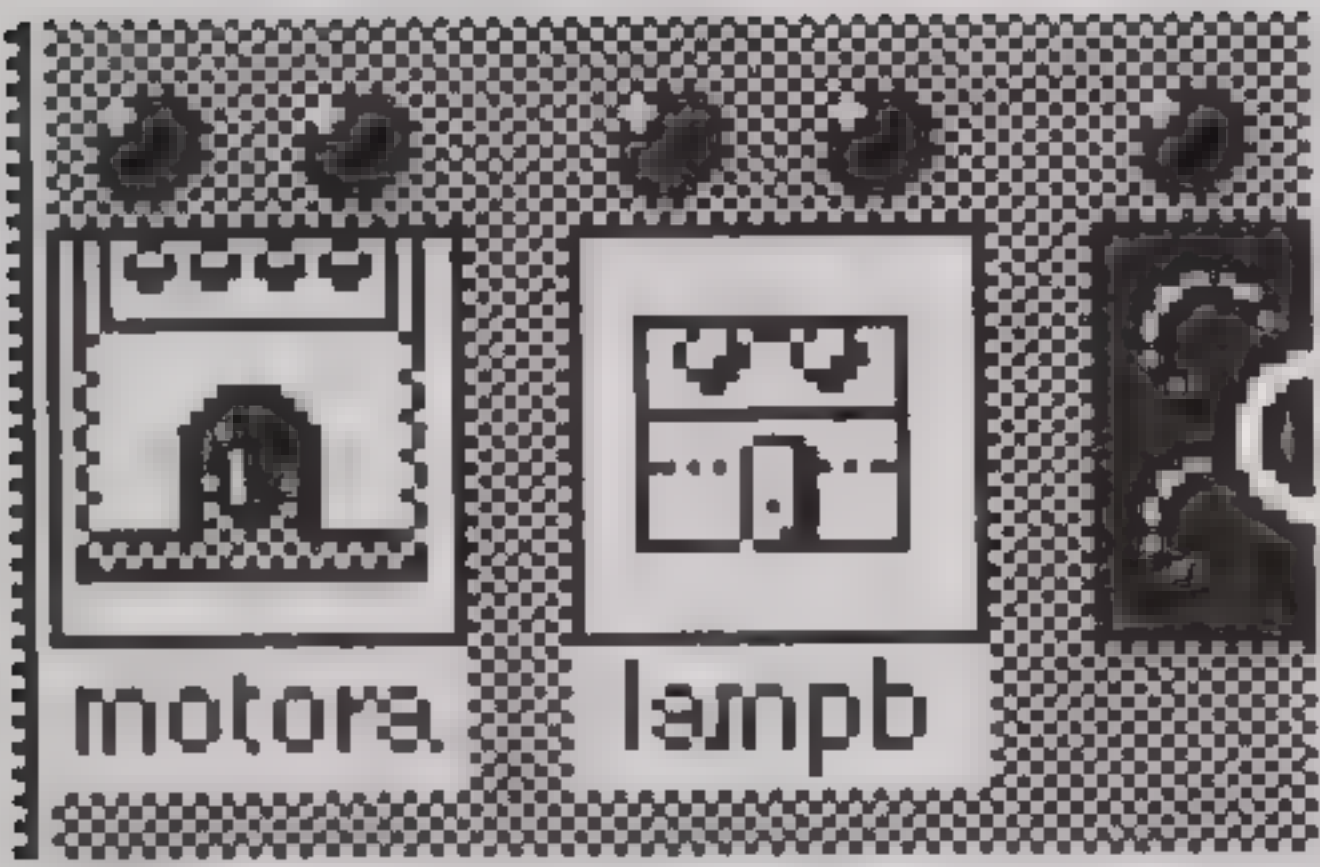
Note also that a corresponding green light above output A on the LEGO DACTA® Serial Interface lights up while the motor is running. Click on the circles above the other output ports on the Setup page and observe the indicator lights on the interface box.

► Clip one end of a second connecting lead to the black output port marked with the letter B, so that the wire hangs down toward the bottom of the box. Connect the other end of the connecting lead to a lamp.



The lamp does not shine when it is connected. This is because no electrical power is available at output port B right now. The lamp turned on when it was connected to the test port earlier because electrical power in this port is always on.





- Select the lamp icon with the mouse and drag it to output port B on the Setup page. Release the mouse button.  
What happens? \_\_\_\_\_

The lamp icon remains on output port B and the name becomes “lampb.” The name “lampb” simply means that the software is expecting that a lamp is connected to port B on the LEGO DACTA Serial Interface . The lamp connection you made on the screen corresponds to the actual lamp connection you made with the second connecting lead.

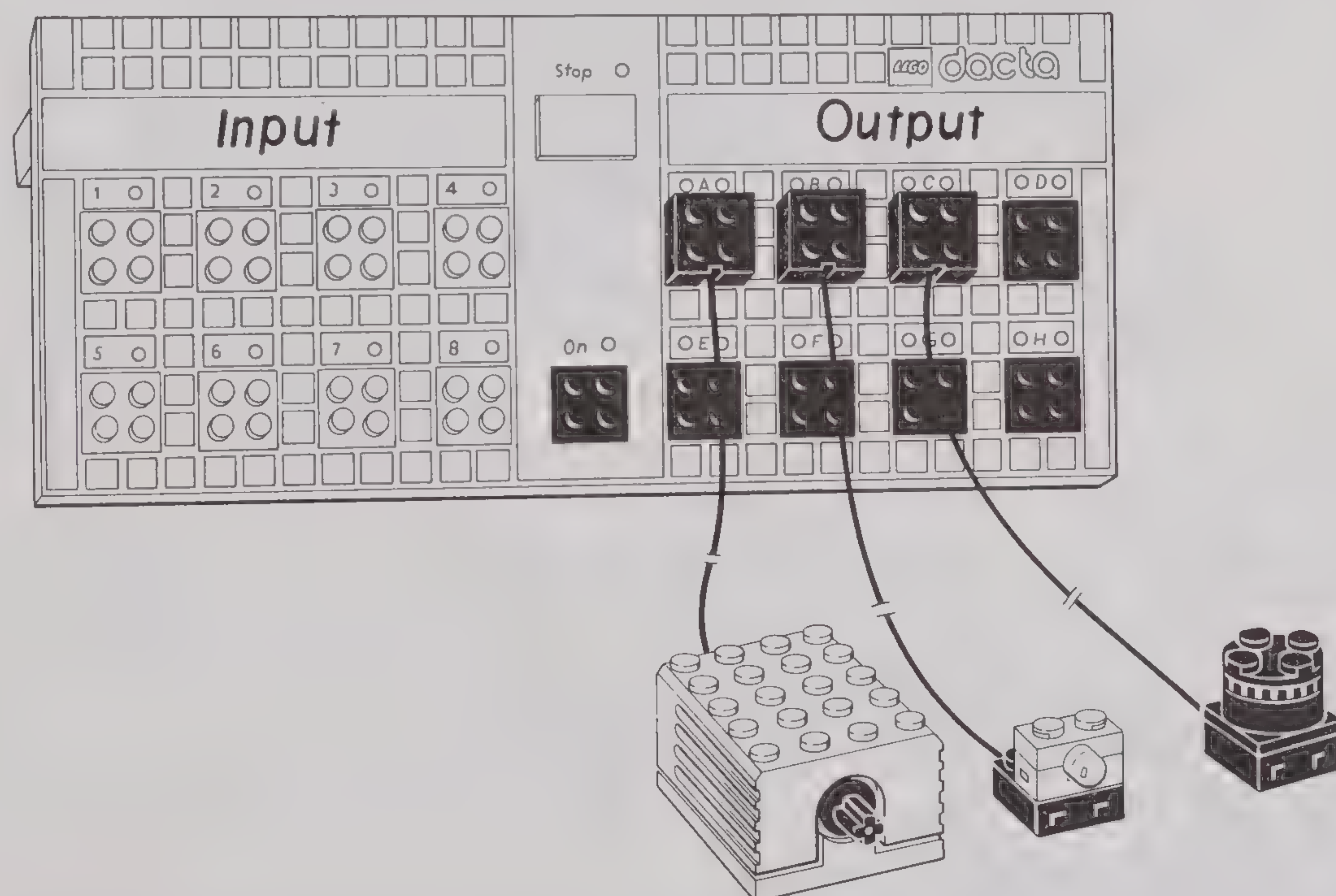
- Point to one of the two small circles above the lampb icon on the Setup page and press down the mouse button.  
What happens? \_\_\_\_\_

The lamp shines as long as you hold the mouse button down.

- Click and hold in the other circle above port B.  
What happens? \_\_\_\_\_

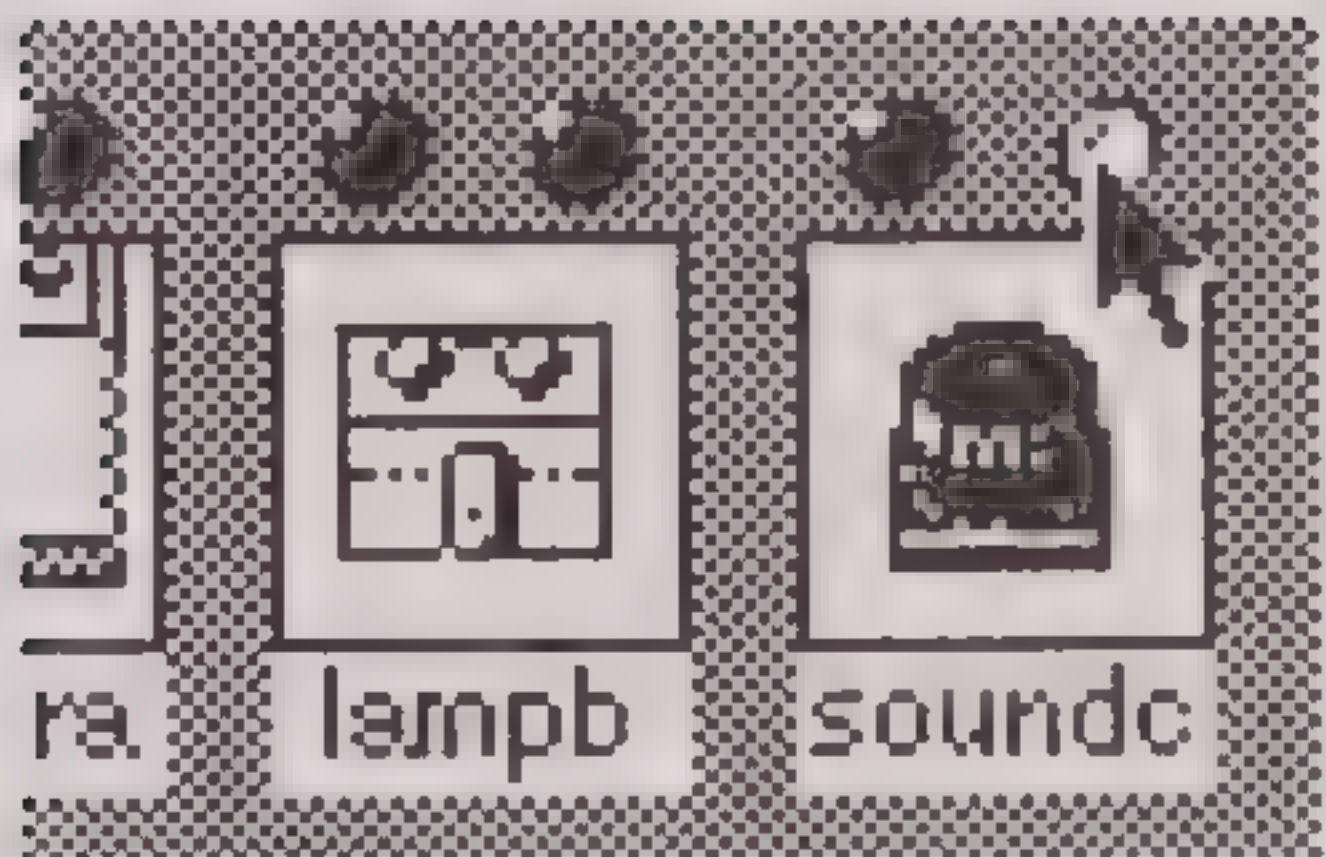
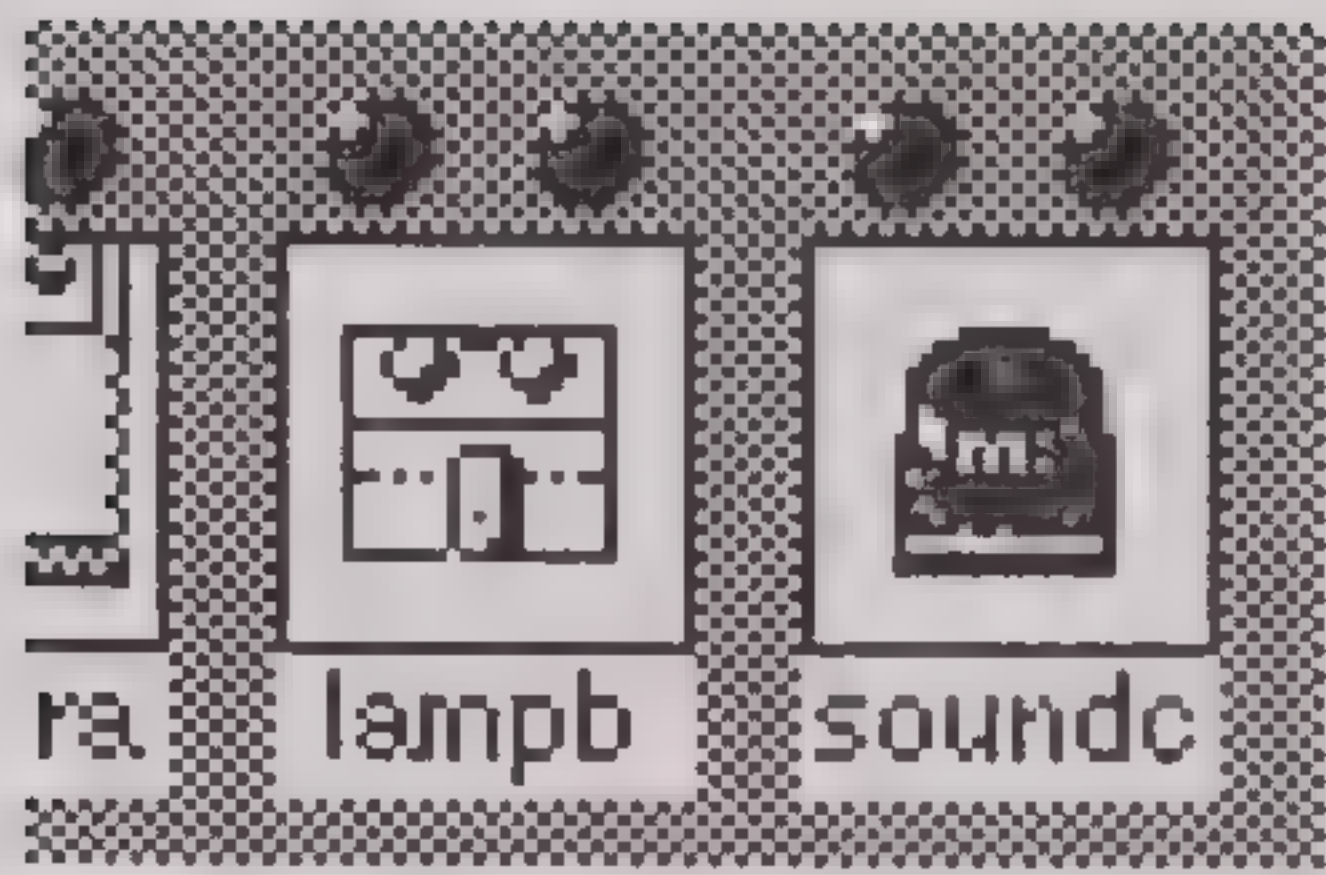
The lamp shines regardless of which direction electricity flows through it.

- Clip one end of a third connecting lead to the black output port marked with the letter C. Connect the other end to a sound element.

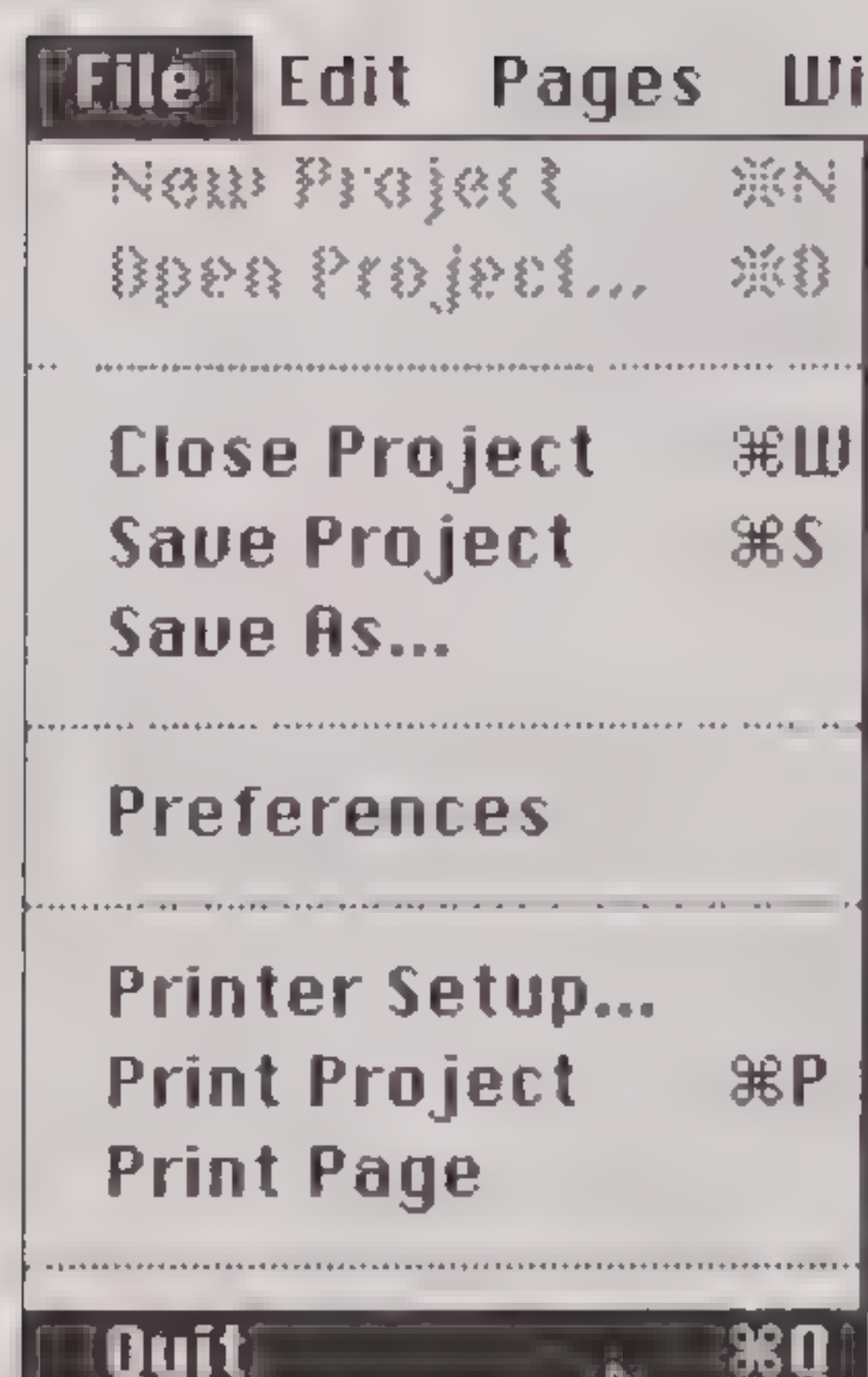


The sound element does not make a sound when it is connected because there is no electrical power available at output port C right now.





If the sound element does not operate, turn the top of the sound element 90 degrees.



► Select the sound icon with the mouse and drag it to output port C on the Setup page.

The sound icon remains on output port C and the name becomes “soundc.” The name “soundc” simply means that the software is now expecting that a sound element is connected to port C on the LEGO DACTA Serial Interface, corresponding to the actual connection you made on the interface box.

► Point to one of the two small circles above the **soundc** icon on the Setup page and press down the mouse button.  
What happens? \_\_\_\_\_

The sound element makes a sound as long as you hold down the mouse button.

► Click and hold in the other circle above output port C.  
What happens? \_\_\_\_\_

The sound element makes another sound because the electricity is flowing through it in the opposite direction.

## Exploration 2 Summary

Now you know how to:

- Connect the motor to the interface box and control its direction using the two output port circles on the Setup page.
- Connect the lamp to the interface box and activate it using the two output port circles on the Setup page.
- Connect the sound element to the interface box and control the sound it makes using the two output port circles on the Setup page.

Click on the File menu and select Quit. Click “No” when asked if you want to save your project.



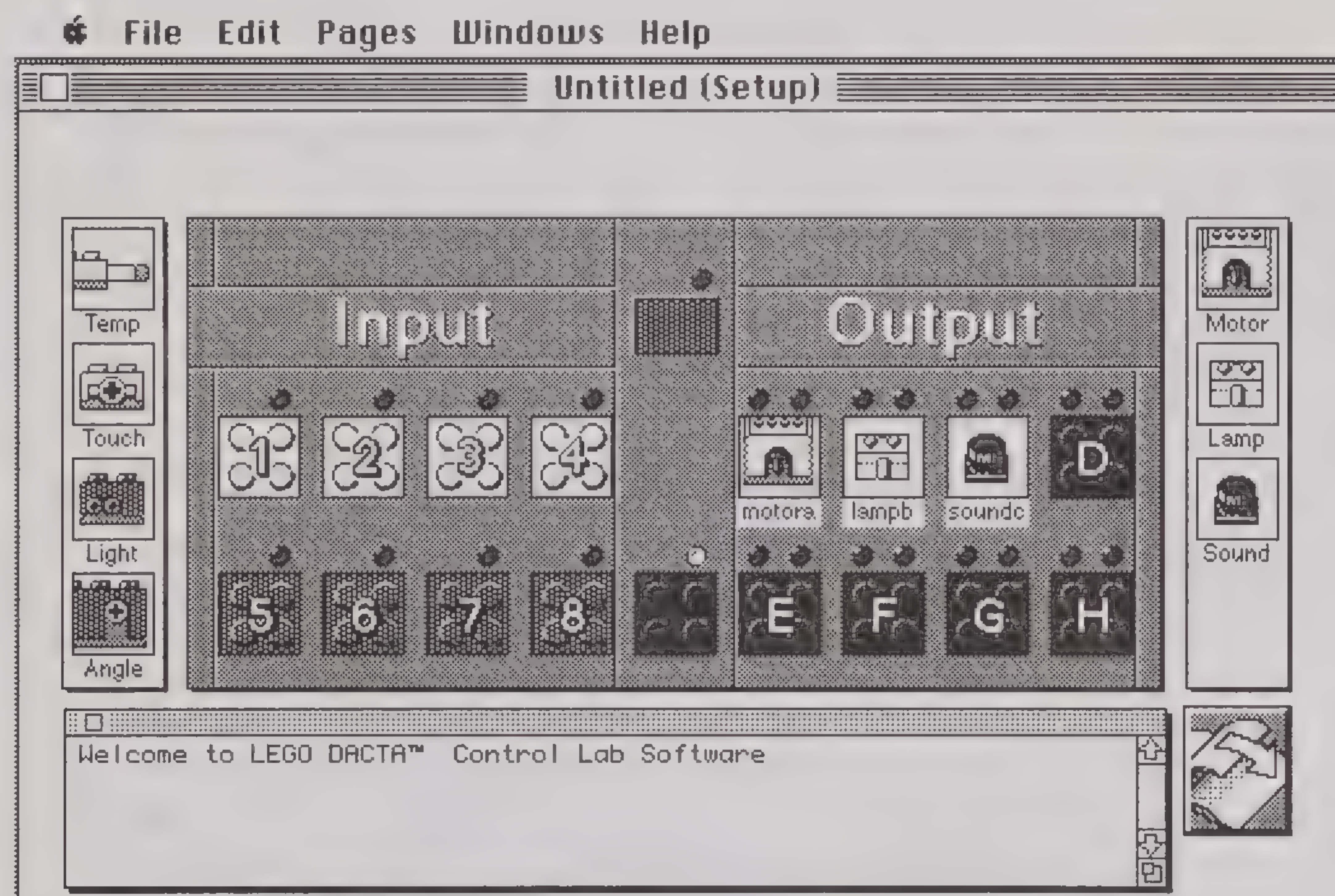
## Exploration 3:

# LEGO DACTA® Control Lab Software - Using Commands

During Exploration 2, you controlled the motor, lamp and sound elements by manually clicking and holding the circles above the output ports on the Setup Page. Exploration 3 explains how to operate the motor, lamp and sound element with Control Lab computer commands.

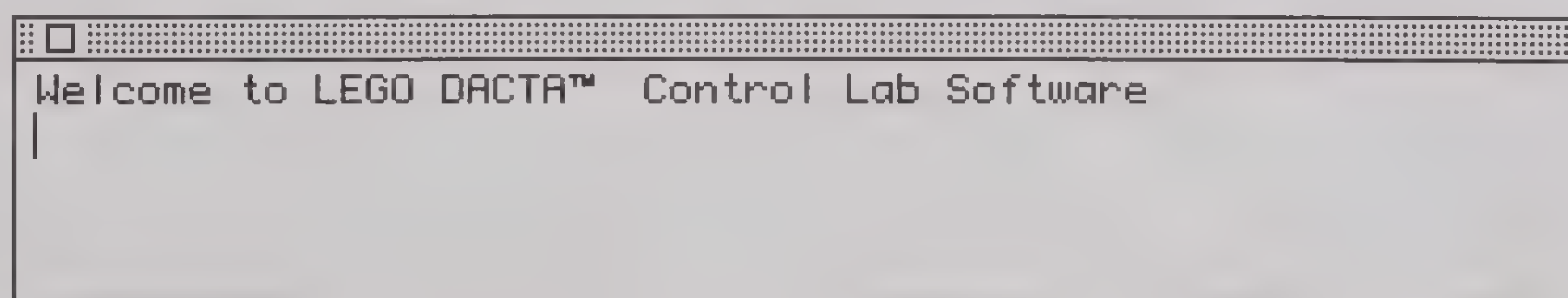
- ▶ Turn on the computer and start the Control Lab software.
- ▶ Click on the File menu and select New Project.
- ▶ Connect the motor to output port A, the lamp to output port B, and the sound element to output port C.
- ▶ Drag the corresponding icons to the respective ports on the Setup page.

The Setup page should look like this.



- ▶ Click in the Command Center window immediately beneath the word “Welcome” to insert the text cursor.

The cursor appears as a blinking vertical line. Anything you type now appears on the screen at the cursor.



See Exploration 2 if you need information about this.

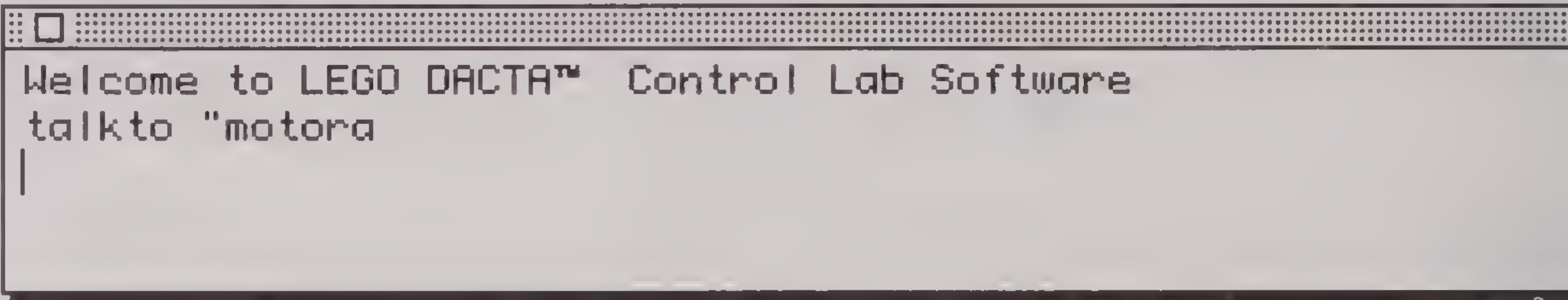
See the Troubleshooting Help section on page 31 of the book if you have difficulty starting the Control Lab system.



It is important to type in the `talkto "motora` command line exactly as shown. Otherwise, the computer may not know what to do. Note that `talkto` is one word. It is followed by a space, then a quotation mark and the word `motora`. There is no closing quotation mark used.

► Type `talkto "motora` at the keyboard and press Return (Macintosh) or Enter (MS-DOS).

The Command Center should look like this, but the motor is not on.



The `talkto` command tells the computer to open the electronic pathway to the motor connected to port A. It is an internal action which you cannot see. The `talkto` command does not turn on the motor; it simply prepares the way.

The LEGO DACTA® Control Lab software responds with various helpful messages when you type something in the Command Center it does not know how to carry out. Here are some examples.

If You Typed:	And The Computer Said:	Then You Must:
<code>talkto</code>	<code>talkto needs more inputs</code>	Include <code>"motora</code>
<code>talkto "motora"</code>	<code>tto does not like motora"</code> <code>as input</code>	Eliminate closing quote
<code>talkto"motora</code>	<code>I don't know how to talkto"motora</code>	Add space between <code>talkto</code> and <code>"motora</code>
<code>talkto motora</code>	<code>I don't know how to motora</code>	Add front quote
<code>talk to "motora</code>	<code>I don't know how to talk</code>	Eliminate space in <code>talk to</code>
If Control Lab produces these or similar messages, simply type in <code>talkto "motora</code> correctly on the next line and press Return or Enter. Or, if you are familiar with how to edit text with the mouse, make the appropriate changes in the line you typed earlier and press Return or Enter.		

► Type `on` and press Return or Enter.

The motor begins running because the computer is sending a message to direct power to port A, the output port it is “talking to.” Note that a green light over output port A on the LEGO DACTA® Serial Interface is shining.



► Press the red Stop button on the LEGO DACTA Serial Interface once. What happens? \_\_\_\_\_

When you press the Stop button on the interface box once, the motor stops and the red light begins flashing.

► Press the Stop button a second time. What happens? \_\_\_\_\_

The motor turns on again and the red light next to the Stop button turns off.

► Type `off` and press Return or Enter to turn off the motor.

► Use the `talkto`, `on` and `off` commands to control the lamp and sound element.

For example, type the following:

```
☐ talkto "lampb
on
talkto "soundc
on
|
```

```
☐ talkto [lampb soundc]
off
|
```

Make sure you type square brackets [ ] and not parentheses ( ) or curly braces { }.

As the Command Center fills with commands, the lines begin to scroll. You can use the scroll arrows on the right side of the Command Center to move up and down to lines which have already been typed.



Notice that both the lamp and sound element can be addressed simultaneously using the square brackets.

► Type `alloff` and press Return or Enter to turn off everything connected to the LEGO DACTA® Serial Interface output ports.



To place the text cursor on a line which has already been typed, simply point to the line and click the mouse button.

The `rd` command is used to reverse the direction of the electricity.

Type `cc` to clear the Command Center.

Instead of typing in the entire line again, you can use the arrow keys to move the text cursor to the right of the number 30. Then delete the number with the Delete key (Macintosh) or Backspace key (MS-DOS) and type in 50. The cursor does not have to be at the end of the line when you press Return or Enter.

► Type `cc` and press Return or Enter to clear everything you have typed in the Command Center.

► Type the following in the Command Center and press Return or Enter after each line. What happens? \_\_\_\_\_

```
talkto "soundc
on
rd
```

The sound element turns on, making one type of sound.

When the computer carries out the `rd` command, it reverses the direction of the electricity to the sound element. This produces a different sound. Also, the other green indicator light above output port C turns on.

► To hear the first sound once more, simply use the up-arrow key (↑) to bring the text cursor to the `rd` line in the Command Center. Then press Return or Enter. Or you can type `rd` again.

► Type `off` in the Command Center and press Return or Enter.

► Type `talkto "motora` in the Command Center and press Return or Enter. Explore with the `on`, `rd`, and `off` commands.

Be sure the motor is on when you type `rd`. If you observe closely, you can see the motor change direction. You can also feel the motor “kick” as it changes direction.

► Type `talkto "lampb on wait 30 off` all on the same line in the Command Center. What happens? \_\_\_\_\_

The lamp turns on for 3 seconds, then turns off. The computer carries out all of the above instructions, one at a time, going from left to right. The `wait` command makes the computer pause before continuing. In this case, the number 30 tells it to pause for three seconds (or 30 tenths of a second).

► Change 30 to 50. Then press Return or Enter. What happens? \_\_\_\_\_

The lamp turns on for 5 seconds, then turns off.



► Type `talkto "motora onfor 40` in the Command Center. What happens?

The motor turns on for 4 seconds. The `onfor` command combines `on`, `wait`, and `off`.

### Exploration 3 Summary

Now you know how to control a motor, lamp, and sound element with computer commands.

Here is a summary of the commands you have learned so far.

Command	Example	Action of Example
talkto	<code>talkto "soundc</code>	Prepares pathway for the computer to send instructions to output port C where a sound element is connected.
	<code>talkto [motora soundc]</code>	Prepares pathway for the computer to send instructions to output port A where a motor is connected and port C where a sound element is connected.
on	<code>on</code>	Sends the instruction to power a port or a list of ports.
off	<code>off</code>	Cuts off electric power to a port or a list of ports.
alloff	<code>alloff</code>	Cuts off electric power to ports A through H.
rd	<code>rd</code>	Reverses direction of electricity to a port or a list of ports.
cc	<code>cc</code>	Clears the Command Center of text.
wait	<code>wait 25</code>	Makes computer pause 2.5 seconds.
onfor	<code>onfor 25</code>	Sends electric power to a port or a list of ports for 2.5 seconds.

Click on the File menu and select Quit. Click “No” when asked if you want to save your project.



## Exploration 4:

### LEGO DACTA® Control Lab Software - Using Sensors

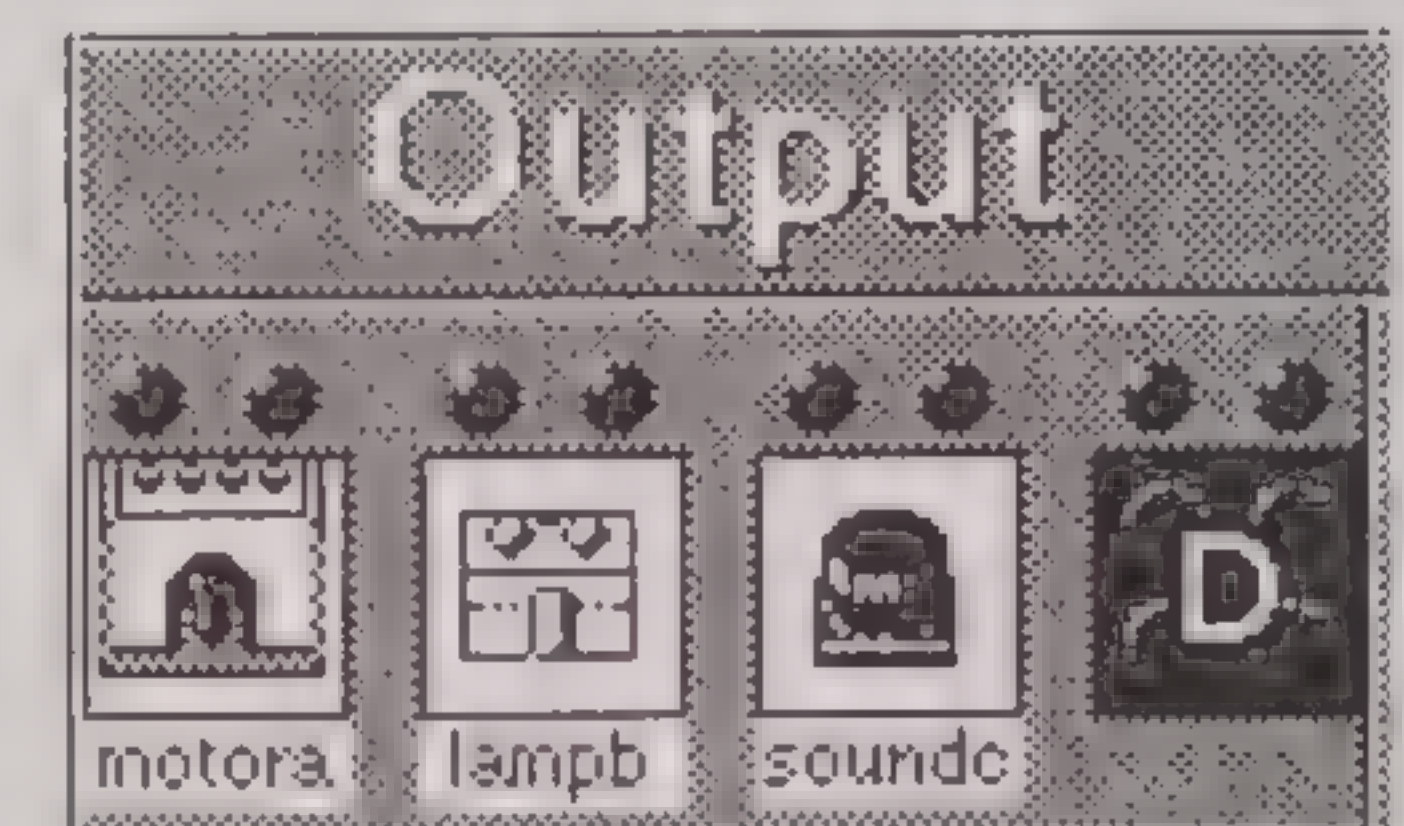
Sensors are like our human senses. Sensors provide information to the computer as our senses provide information to our brain.

In this exploration, you will learn to control the motor, lamp, and sound element with information from sensors.

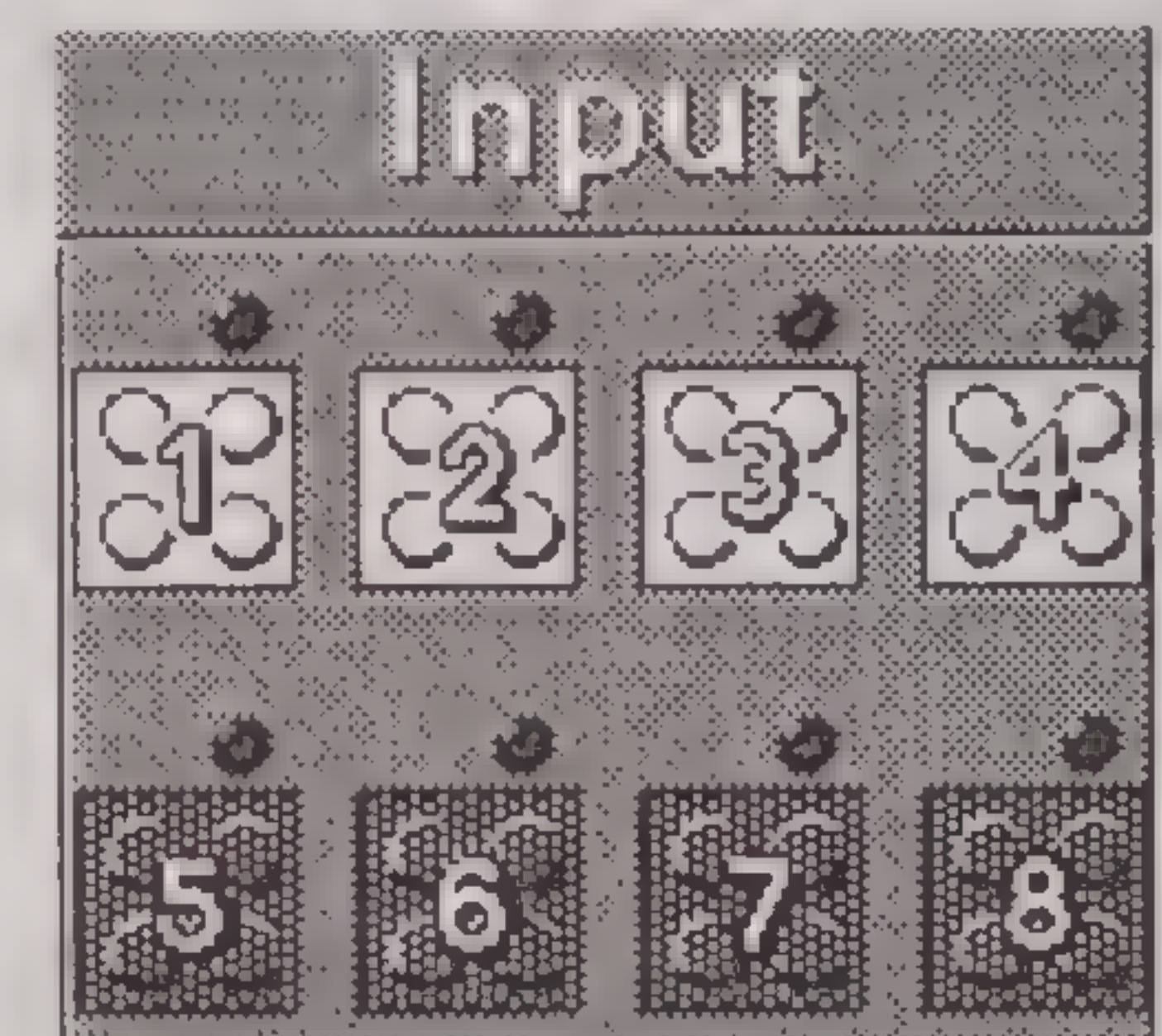
► Turn on the computer and start the Control Lab software. Connect the motor to output port A, the lamp to output port B and the sound element to output port C.

► Drag the corresponding icons to the respective ports on the Setup page.

The output part of the Setup page should look like this.



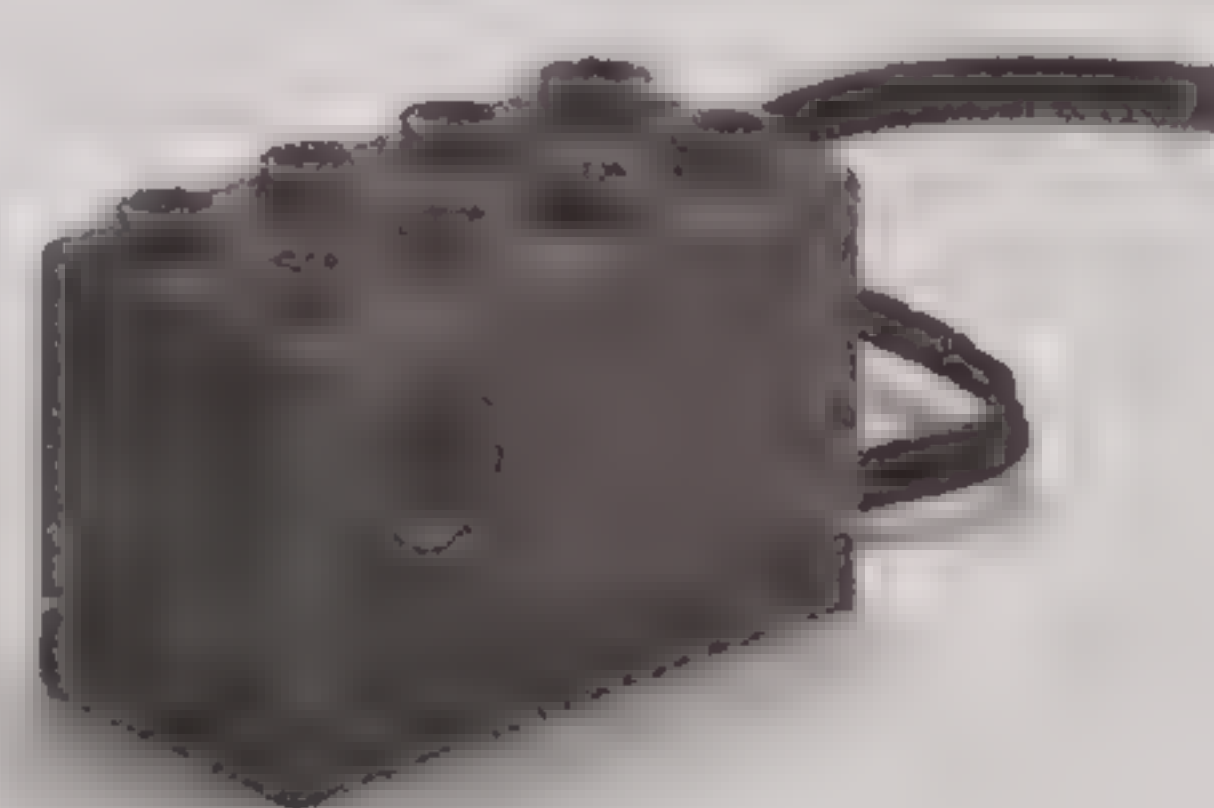
► Now look at the LEGO DACTA® Serial Interface itself. Find the yellow and blue input ports numbered 1 through 8 on the left side of the interface box. The yellow ports are numbered 1 through 4. The blue ports are numbered 5 through 8. Sensors connected to these ports can provide information to the computer.



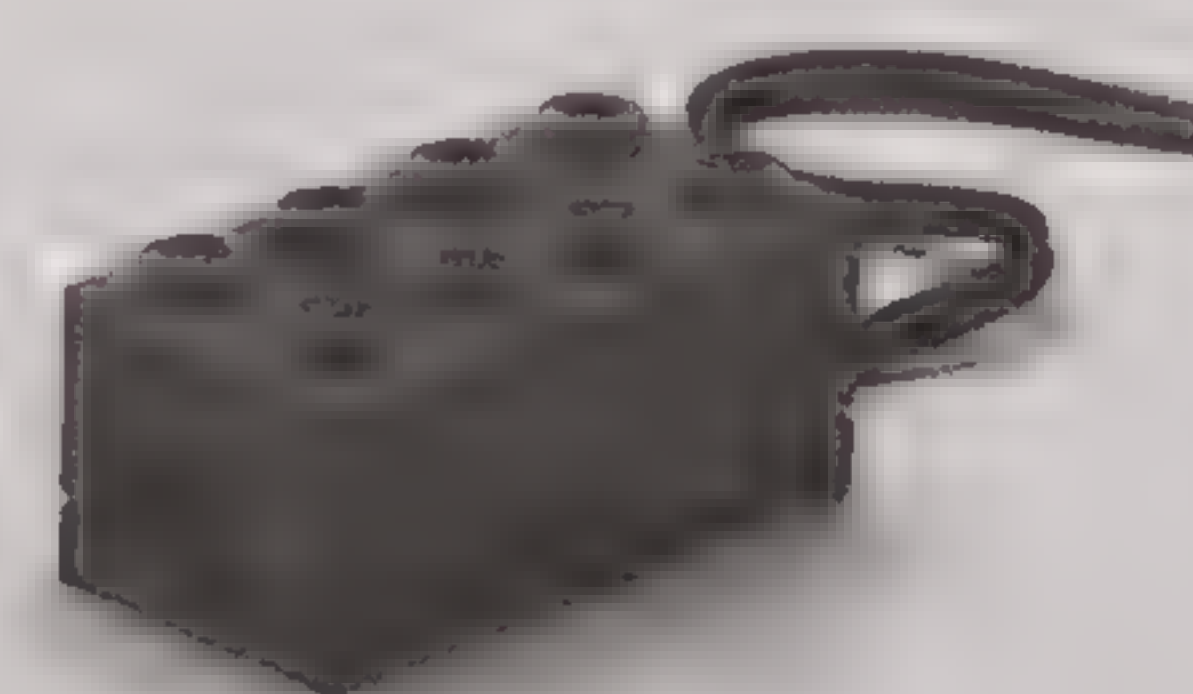
There are two types of LEGO DACTA® sensors. Yellow sensors connect to the yellow input ports and do not require any electrical power to function. Blue sensors connect to the blue input ports and do require electrical power to function.

The yellow (unpowered) sensors consist of a **touch sensor** and a **temperature sensor**. These sensors are not included with Control System and may be purchased separately, if desired.

The blue (powered) sensors included with Control System are an **angle sensor** and a **light sensor**. Each sensor has a connecting lead permanently attached to it. Both the sensor and the end of the connecting lead are colored blue.



Angle Sensor

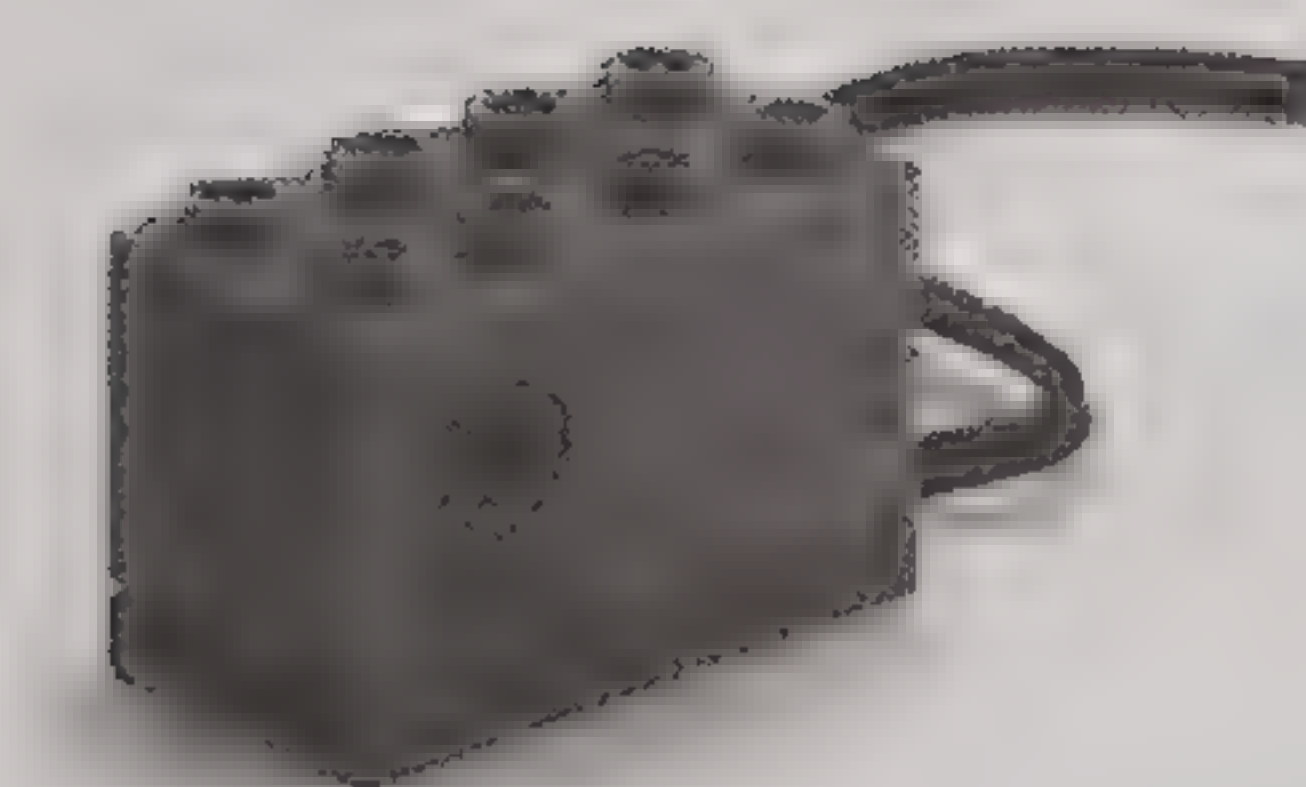


Light Sensor

See Explorations 1 and 2 for more information if necessary.

See the Troubleshooting Help section on page 31 if you have difficulty starting the Control Lab system.





Angle Sensor

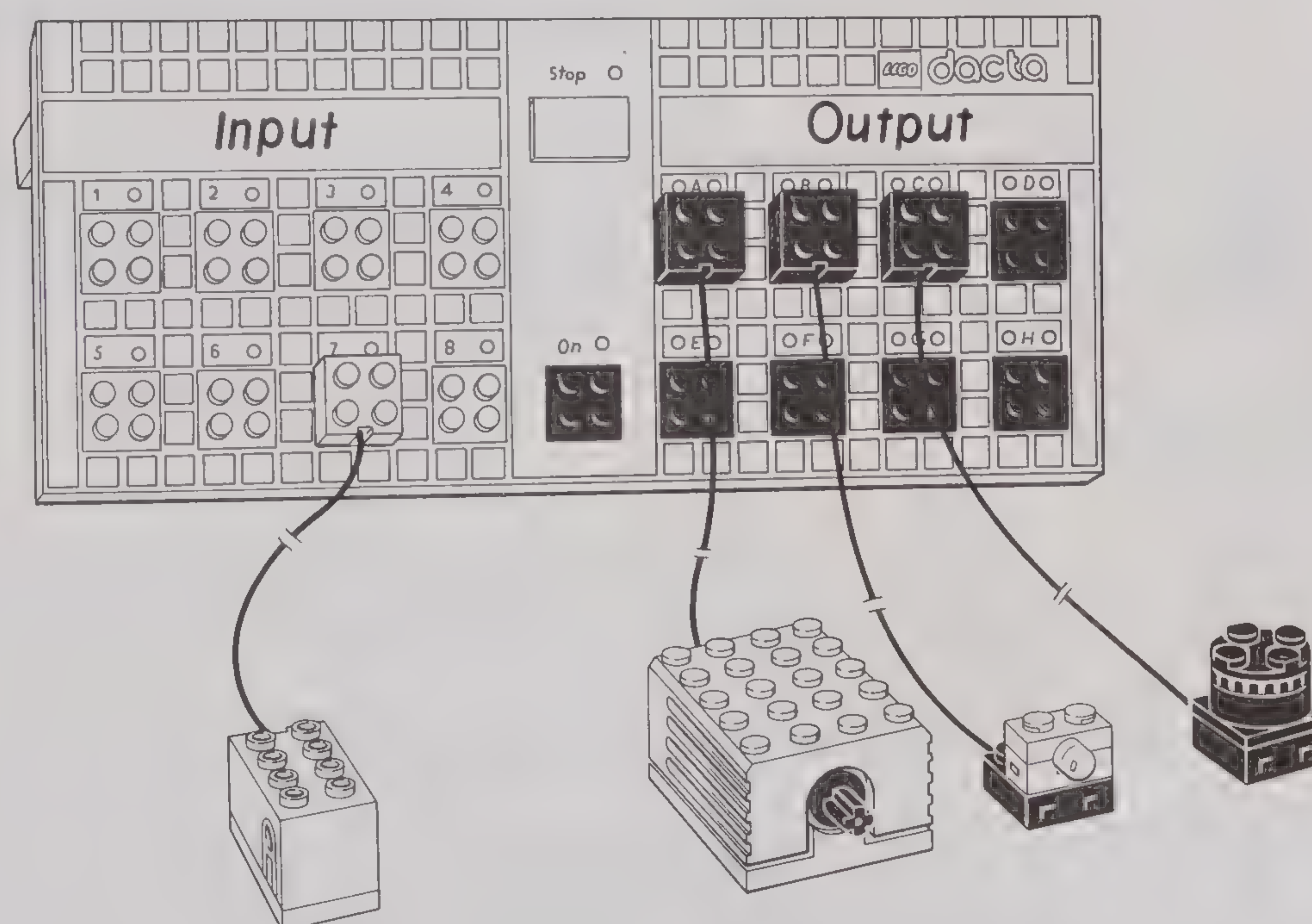
- Find the small notch or channel at the back end of each sensor.

This channel gives the connecting lead wire a pathway if the back end of a sensor is placed against another building element in a model. The wire can go either up the channel or down the channel.

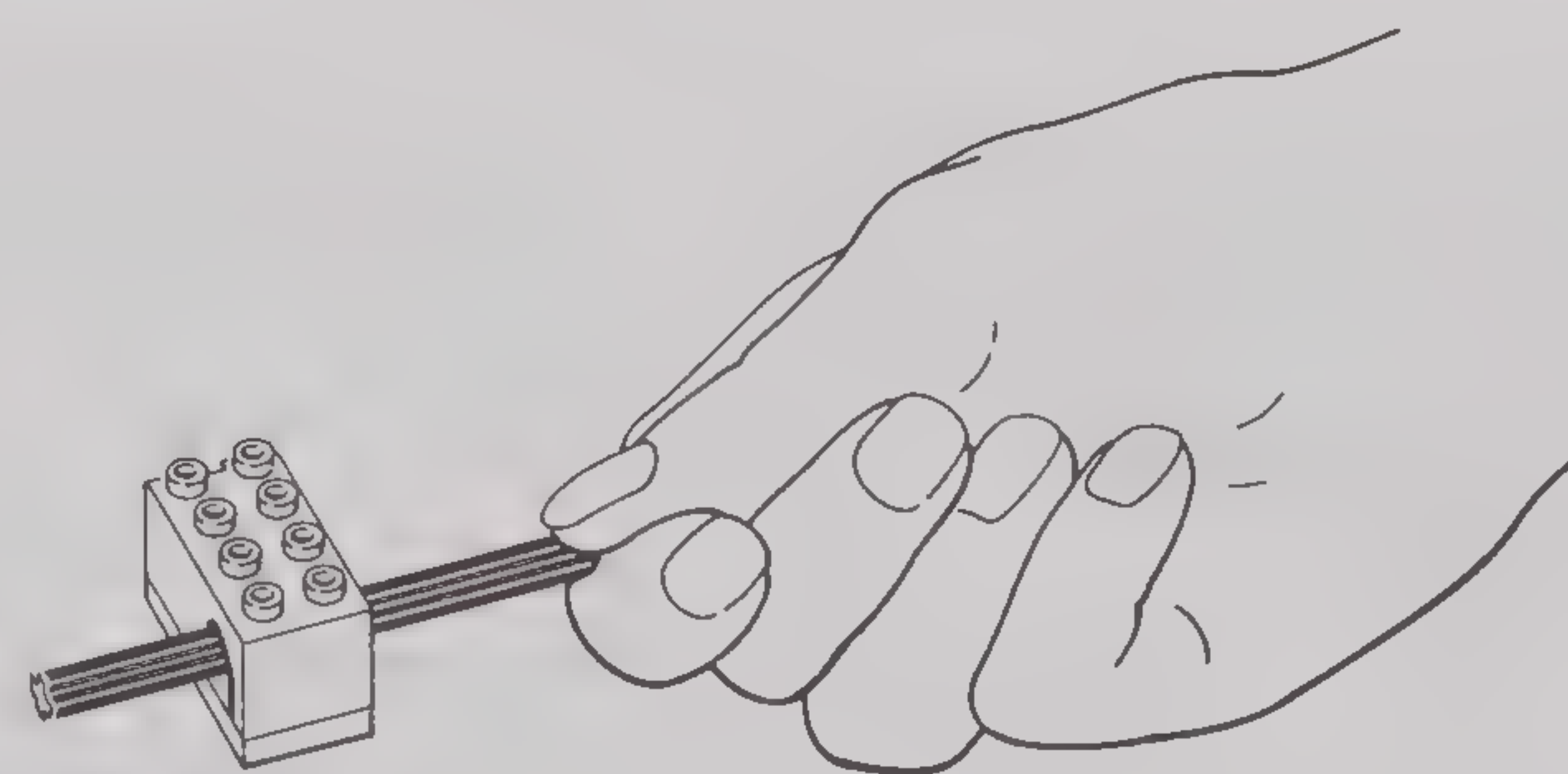
Since the wire provides the electrical pathway in and out of the sensor, none of the sensor housings have metallic studs or metal recesses. However, all of the sensors can be used as building elements and can be incorporated into the structure of models.

### Angle Sensor

- Clip the connecting lead of the blue angle sensor to input port 7 on the LEGO DACTA Serial Interface.

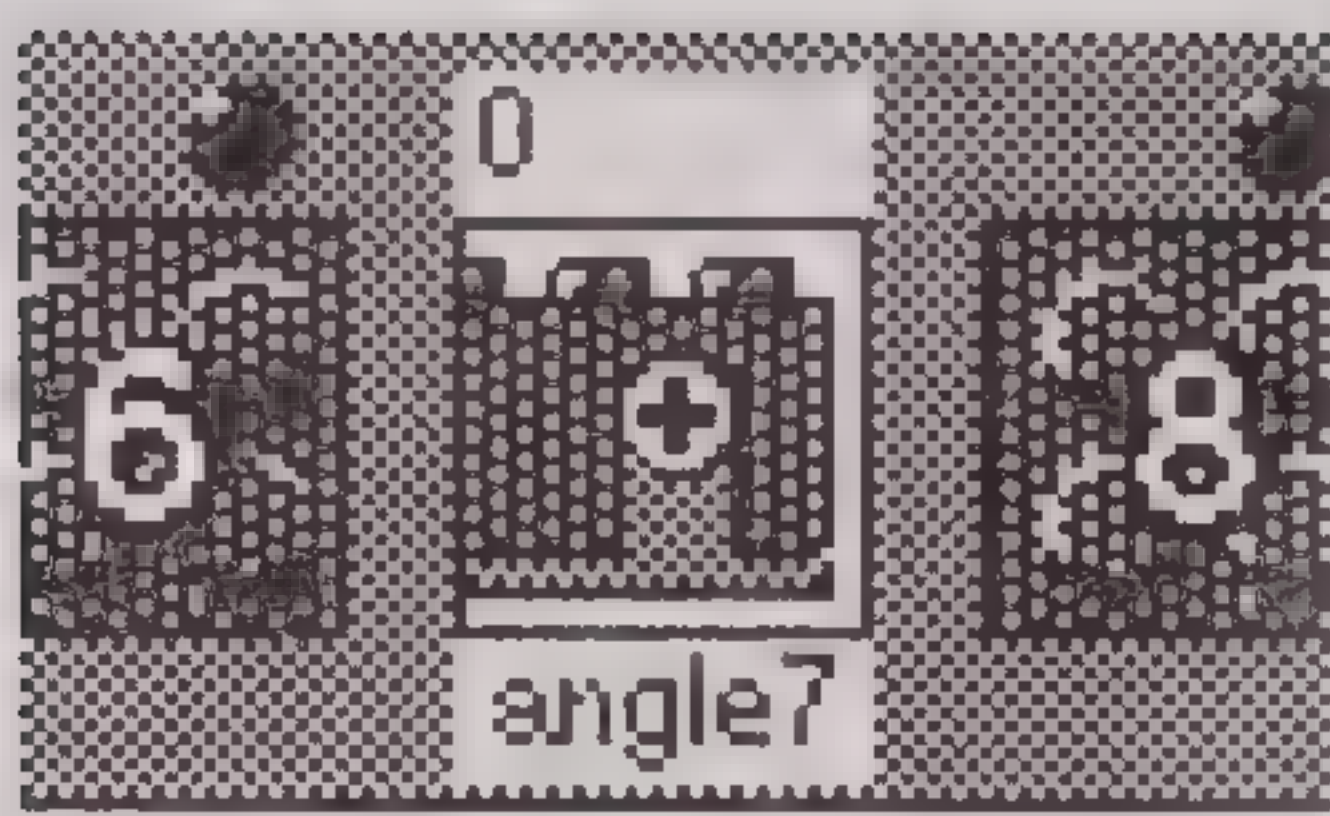


- Insert an axle through the + shaped hole in the angle sensor. Turn the axle slowly in one direction and then in the other.



Note that the light above the input port blinks on and off, indicating that the sensor is changing values.





The angle sensor is a device which can report a wide range of positive and negative rotation values.

Type `angle7` as one word, with no quotation marks.

Make sure you use square brackets. The ">" symbol means "greater than."

Type one space before and one space after the ">" symbol.

The blue angle sensor can report the amount of turning up to speeds of about 500 revolutions per minute. Above that speed, the angle sensor readings are not reliable.

- Drag an angle sensor icon to input port 7 on the Setup page.

The angle sensor icon remains on input port 7 and the name becomes "angle7" automatically. The name "angle7" means that the LEGO DACTA® Control Lab software expects that an angle sensor is connected to input port 7 on the interface box. The angle sensor connection you made on the Setup page corresponds to the actual sensor connection you made on the LEGO DACTA Serial Interface.

- Gently grasp the axle and turn it slowly once more. What happens? \_\_\_\_\_

The angle sensor number changes as the axle moves. The numbers represent the angle of turning. One complete turn is 16 units.

- Now reverse the direction of your turning. What happens? \_\_\_\_\_

As you turn in one direction, the numbers increase. The numbers decrease when you turn in the other direction. This means that the angle sensor reports both the amount and the direction of turning.

- Click in the Command Center, type `show angle7` and press Return or Enter.

When you press Return or Enter, Control Lab prints the angle reading at that moment on the next line in the Command Center.

- Select a number higher than the current angle sensor reading.

For example, if the current reading is 120, you can select 150. Higher number selected: \_\_\_\_\_

- Type `waituntil [angle7 > ____] talkto "soundc on` in the Command Center and press Return or Enter. Substitute your higher number for the blank.

The sound element should still be connected to output port C. You hear nothing yet because the angle sensor reading is lower than your number.

- Turn the axle so that the angle sensor number increases.

When the angle number is greater than the number you typed in, LEGO DACTA Control Lab turns on the sound element.

- Turn off the sound element by typing `off` in the Command Center and press Return or Enter.



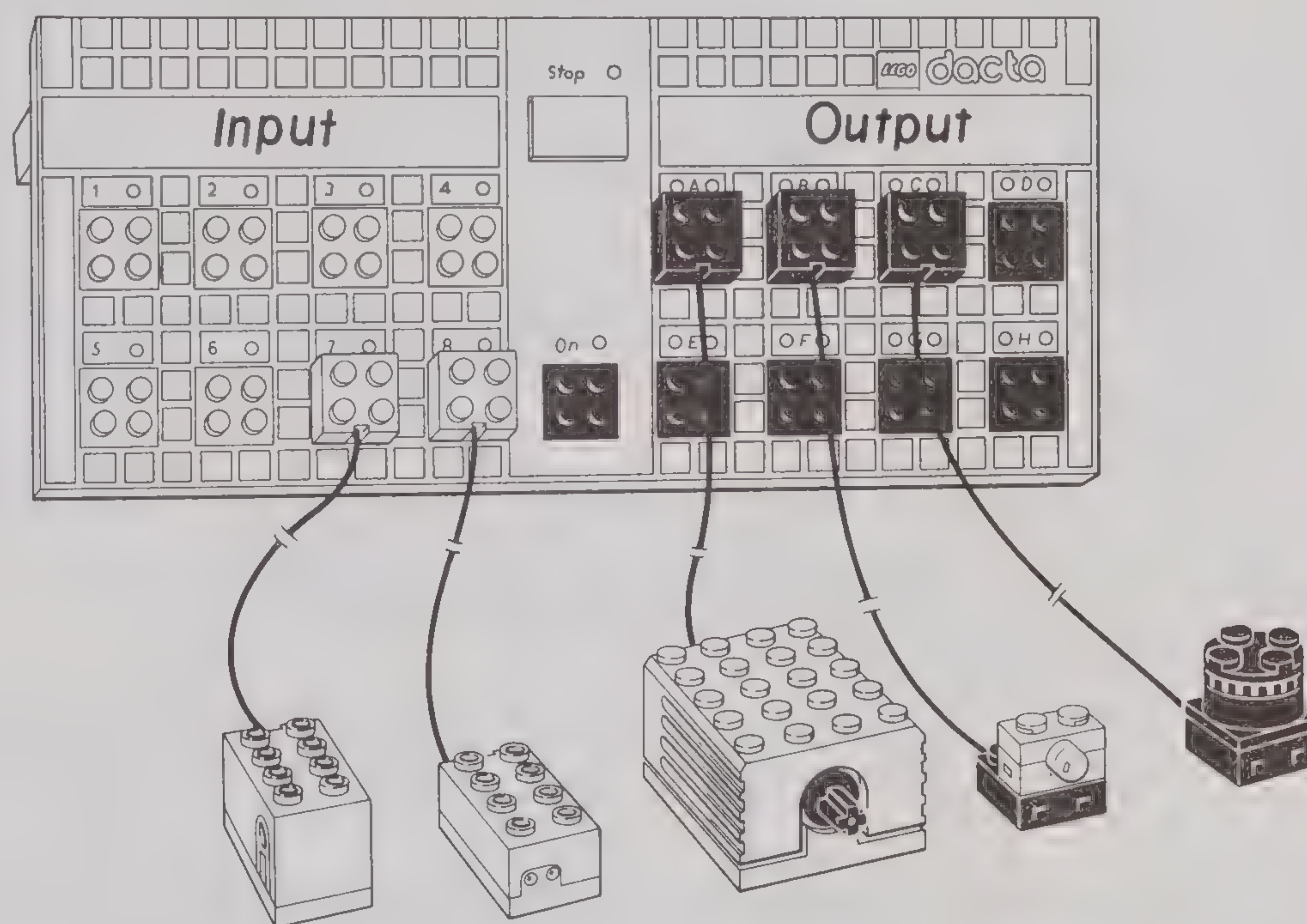


Light Sensor

## Light Sensor

The light sensor can “see” reflected and ambient light (the light in the room around the sensor.)

► Clip the connecting lead of the blue colored light sensor to input port 8 on the LEGO DACTA® Serial Interface.



A small red light at the end of the light sensor begins shining.

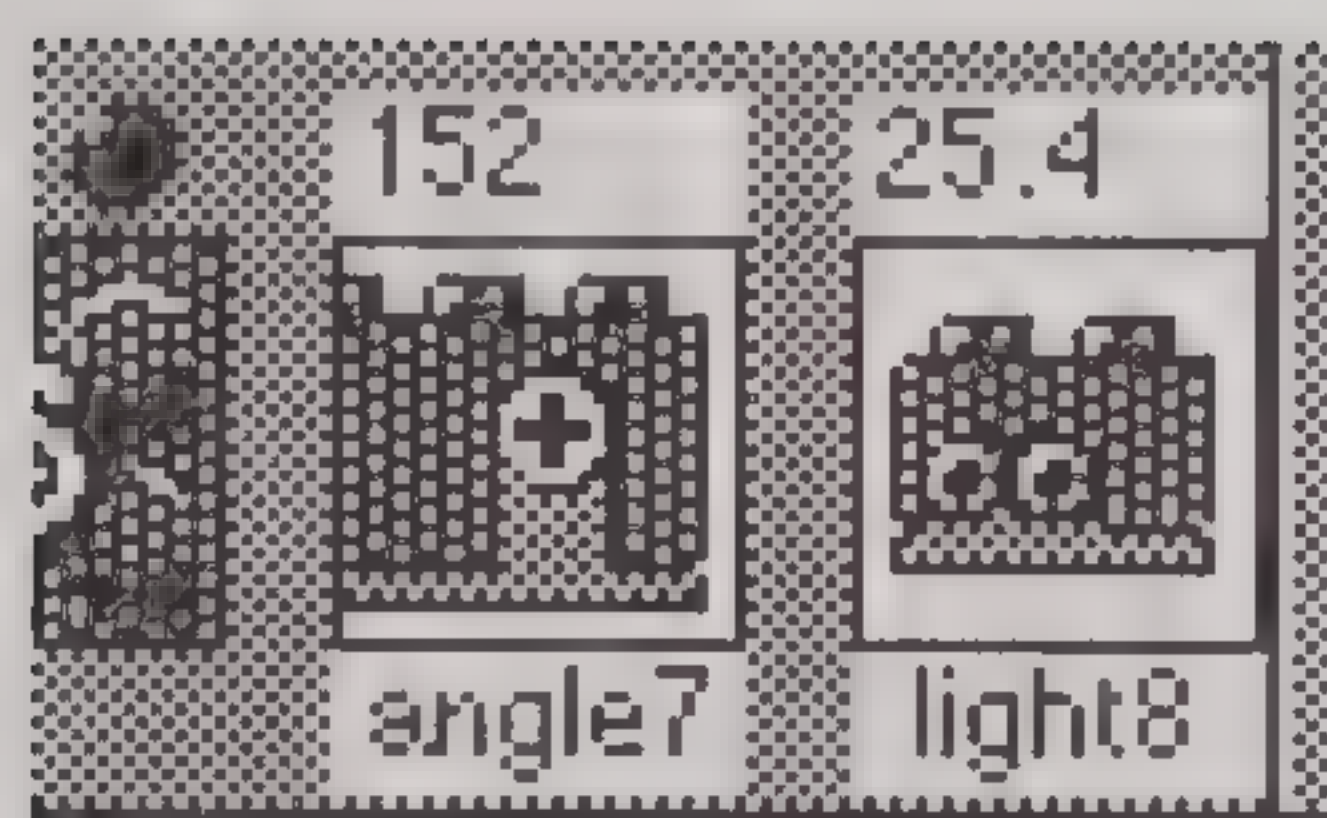
The actual light sensing mechanism is housed in the clear window next to the red light on the sensor.

► Drag a light sensor icon to input port 8 on the Setup page.

The light sensor icon remains on input port 8 and the name becomes “light8” automatically. The name “light8” means that LEGO DACTA Control Lab expects that a light sensor is connected to input port 8 on the LEGO DACTA Serial Interface.

The light sensor connection you made on the Setup page corresponds to the actual sensor connection you made on the interface box.

A number appears over the light sensor icon on the screen. This means that the sensor and interface box are sending numbers to the computer. The numbers represent the intensity of the light reaching the sensor. The numbers can range from 0 (dark) to 100 (bright).





The light sensor is a device which can report a range of specific values for light intensity.

Type `light8` as one word, with no quotation marks and no space between `light` and `8`.

Make sure you use square brackets. The `>` symbol means "greater than."

Make sure you type one space before and one space after the `>` symbol.

► Pick up the light sensor and point it toward various objects both dark and light. Observe how the numbers change.

► What is the highest number you can produce? \_\_\_\_\_  
What is the lowest? \_\_\_\_\_

In general, the more light that enters the sensor, the higher the number it reports.

► Click in the Command Center, type `show light8` and press Return or Enter.

When you press Return or Enter, Control Lab prints the light reading at that moment on the next line in the Command Center.

► Select a number about in the middle of all the numbers you produced with the light sensor.  
Middle number selected: \_\_\_\_\_

For example, if your highest number was 70 and your lowest number was 20, you might select a middle number of 50.

► Make sure the lamp is still connected to output port B.

► Place the light sensor in a dark area so that it reports a low number.

► Then type `waituntil [light8 > ____] talkto "lamp on` in the Command Center and press Return or Enter. Substitute your middle number for the blank.

Nothing should happen yet because the light sensor reading is lower than your number.

► Move the light sensor slowly toward something giving off more light.

► Watch the light sensor numbers as they increase.

When the light sensor number is greater than the number you typed in, LEGO DACTA Control Lab turns on the lamp.

► Turn off the lamp by typing `off` in the Command Center and pressing Return or Enter.

► Click on the File menu and select Quit. Click "No" at the dialog box asking if you want to save the project.



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## Exploration 4 Summary

Now you know how to:

- Attach the angle sensor and the light sensor to the blue input ports.
- Use both sensors to control a motor, lamp and sound element.

Here is a summary of the commands you have learned to use with the sensors.

Command	Example	Action of Example
show	show angle7	Displays the current reading of the angle sensor connected to port 7.
waituntil	waituntil [angle7 > 150]	Makes computer pause until the angle sensor connected to port 7 reports a value greater than 150.
>	show light8 > 35	Reports “true” when the reading from the light sensor connected to input port 8 is greater than 35, otherwise reports “false.”
<	show angle7 < 150	Reports “true” when the reading from the angle sensor connected to input port 7 is less than 150, otherwise reports “false.”

## Introductory Explorations Summary

Congratulations! You have now completed the *LEGO DACTA® Control System Setup Guide*. By using this book, you have learned a lot about the LEGO DACTA Serial Interface and the motors, lamps, sound elements and sensors which connect to it. You are now ready for the activities in the *LEGO DACTA Control System Teacher Guide*.



# Introductory Explorations Progress Checklist

Check each box to record your progress.

## Exploration 1: Using the Motor, Lamp, and Sound Element

- ☐ Make sure the LEGO DACTA® Serial Interface is connected to the computer and is being powered by the transformer.
- ☐ From the LEGO DACTA Simple Control building set (item #9702), take out one motor, one lamp, one sound element, and one connecting lead.
- ☐ Pick up the connector plate on the end of the connecting lead. Examine the small metal parts in the studs on top of the connector plates at the ends of the wires.
- ☐ Examine the metal edges in the recessed bottom of the connector plate.
- ☐ Examine the motor, lamp and sound element. Find the metal components which provide an electrical path through each element.
- ☐ Clip the bottom of one connector plate to the test port on the LEGO DACTA Serial Interface. Let the connecting lead hang down from the test port toward the bottom of the interface box.
- ☐ Clip the bottom of the sound element to the four studs on top of the other connector plate on the connecting lead.
- ☐ Grasp the top of the sound element and turn it. Listen to the sound.
- ☐ Explore how to control the sound by turning the top of the sound element.
- ☐ Does the sound element work if it is clipped onto only two of the four studs on the connector plate? \_\_\_\_\_ Be sure to turn the top of the sound element to all four positions.
- ☐ If the connector plate is fastened to the studs on top of the sound element, is any sound produced? \_\_\_\_\_
- ☐ Replace the sound element with the lamp. Notice that the lamp lights up when it is clipped to the top or the bottom of the connector plate.
- ☐ Put the lamp aside and clip the motor to the connector plate.
- ☐ Explore the possible connection combinations.
- ☐ Can you find any connections for which the motor does not run? \_\_\_\_\_
- ☐ Can you connect both the sound element and the lamp to the end of the connecting lead to produce both light and sound? \_\_\_\_\_  
Can you connect the motor, the lamp and the sound element so that all three are running at once? \_\_\_\_\_
- ☐ Disconnect all elements from the connecting lead. Disconnect the connecting lead from the test port.



Check each box to record your progress.

## Exploration 2: LEGO DACTA® Control Lab Software - Making Connections

- ☐ Make sure the LEGO DACTA Serial Interface, transformer and cable are installed properly.
- ☐ Turn on the computer.
- ☐ Start the Control Lab software.
- ☐ Click on the Control Lab title screen and wait until it has changed.
- ☐ Test the interface box by pressing the red Stop button once.
- ☐ Push the Stop button a second time to restore power to the output ports.
- ☐ Locate the Command Center; it is the window near the bottom of the screen. Do not type any commands just yet.
- ☐ Click on the File menu and select New Project.
- ☐ Now look at the interface box itself. Clip one end of a connecting lead to the black output port marked with the letter A, so that the wire hangs down toward the bottom of the box.
- ☐ Connect the other end of the connecting lead to a motor.
- ☐ Select the motor icon with the mouse and drag it to output port A on the Setup page. Release the mouse button.
- ☐ Using the mouse, point to one of the two small circles above the **motor** icon on the Setup page. Press down the mouse button. What happens? \_\_\_\_\_
- ☐ Click and hold the pointer in the other circle above port A. What happens? \_\_\_\_\_
- ☐ Clip one end of a second connecting lead to the black output port marked with the letter B, so that the wire hangs down toward the bottom of the box. Connect the other end of the connecting lead to a lamp.
- ☐ Select the lamp icon with the mouse and drag it to output port B on the Setup page. Release the mouse button. What happens? \_\_\_\_\_
- ☐ Point to one of the two small circles above the **lamp** icon on the Setup page and press down the mouse button. What happens? \_\_\_\_\_
- ☐ Click and hold in the other circle above port B. What happens? \_\_\_\_\_
- ☐ Clip one end of a third connecting lead to the black output port marked with the letter C. Connect the other end to a sound element.
- ☐ Select the sound icon with the mouse and drag it to output port C on the Setup page.
- ☐ Point to one of the two small circles above the **sound** icon on the Setup page and press down the mouse button. What happens? \_\_\_\_\_
- ☐ Click and hold in the other circle above output port C. What happens? \_\_\_\_\_
- ☐ Click on the File menu and select Quit. Click “No” when asked if you want to save your project.



Check each box to record your progress.

### Exploration 3: LEGO DACTA® Control Lab Software - Using Commands

- ☐ Turn on the computer and start the Control Lab software.
- ☐ Click on the File menu and select New Project.
- ☐ Connect the motor to output port A, the lamp to output port B, and the sound element to output port C.
- ☐ Drag the corresponding icons to the respective ports on the Setup page.
- ☐ Click in the Command Center window immediately beneath the word "Welcome" to insert the text cursor.
- ☐ Type `talkto "motora` at the keyboard and press Return (Macintosh) or Enter (MS-DOS).
- ☐ Type `on` and press Return or Enter.
- ☐ Press the red Stop button on the LEGO DACTA Serial Interface once. What happens? \_\_\_\_\_
- ☐ Press the Stop button a second time. What happens? \_\_\_\_\_
- ☐ Type `off` and press Return or Enter to turn off the motor.
- ☐ Use the `talkto`, `on` and `off` commands to control the lamp and sound element.
- ☐ Type `alloff` and press Return or Enter to turn off everything connected to the LEGO DACTA Serial Interface output ports.
- ☐ Type `cc` and press Return or Enter to clear everything you have typed in the Command Center.
- ☐ Type the following in the Command Center and press Return or Enter after each line. What happens? \_\_\_\_\_

```
☐ talkto "soundc  
on  
rd
```

- ☐ To hear the first sound once more, simply use the up-arrow key (↑) to bring the text cursor to the `rd` line in the Command Center. Then press Return or Enter. Or you can type `rd` again.
- ☐ Type `off` in the Command Center and press Return or Enter.
- ☐ Type `talkto "motora` in the Command Center and press Return or Enter. Explore with the `on`, `rd`, and `off` commands.
- ☐ Type `talkto "lampb on wait 30 off` all on the same line in the Command Center. What happens? \_\_\_\_\_
- ☐ Change 30 to 50. Then press Return or Enter. What happens? \_\_\_\_\_
- ☐ Type `talkto "motora onfor 40` in the Command Center. What happens? \_\_\_\_\_
- ☐ Click on the File menu and select Quit. Click "No" when asked if you want to save your project.



Check each box to record your progress.



Angle Sensor

### Exploration 4: LEGO DACTA® Control Lab Software - Using Sensors

- ☐ Turn on the computer and start the Control Lab software. Connect the motor to output port A, the lamp to output port B and the sound element to output port C.
- ☐ Drag the corresponding icons to the respective ports on the Setup page.
- ☐ Now look at the LEGO DACTA Serial Interface itself. Find the yellow and blue input ports numbered 1 through 8 on the left side of the interface box.
- ☐ Find the small notch or channel at the back end of each sensor.

#### Angle Sensor

- ☐ Clip the connecting lead of the blue angle sensor to input port 7 on the LEGO DACTA Serial Interface.
- ☐ Insert an axle through the + shaped hole in the angle sensor. Turn the axle slowly in one direction and then in the other.
- ☐ Drag an angle sensor icon to input port 7 on the Setup page.
- ☐ Gently grasp the axle and turn it slowly once more.  
What happens? \_\_\_\_\_
- ☐ Now reverse the direction of your turning.  
What happens? \_\_\_\_\_
- ☐ Click in the Command Center, type `show angle7` and press Return or Enter.
- ☐ Select a number higher than the current angle sensor reading. \_\_\_\_\_
- ☐ Make sure that the sound element is still connected to output port C.
- ☐ Type `waituntil [angle7 > ____] talkto "soundc on` in the Command Center and press Return or Enter. Substitute your number for the blank.
- ☐ Turn the axle so that the angle sensor number increases.
- ☐ Turn off the sound element by typing `off` in the Command Center and press Return or Enter.



Check each box to record your progress.



Light Sensor

### Light Sensor

- ☐ Clip the connecting lead of the blue colored light sensor to input port 8 on the LEGO DACTA® Serial Interface.
- ☐ Drag a light sensor icon to input port 8 on the Setup page.
- ☐ Pick up the light sensor and point it toward various objects both dark and light. Observe how the numbers change.
- ☐ What is the highest number you can produce? \_\_\_\_\_  
What is the lowest? \_\_\_\_\_
- ☐ Click in the Command Center, type `show light8` and press Return or Enter.
- ☐ Select a number about in the middle of all the numbers you produced with the light sensor. Middle number selected: \_\_\_\_\_
- ☐ Make sure the lamp is still connected to output port B.
- ☐ Place the light sensor in a dark area so that it reports a low number.
- ☐ Then type `waituntil [light8 > ____] talk to "lampb on` in the Command Center and press Return or Enter. Substitute your middle number for the blank.
- ☐ Move the light sensor slowly toward something giving off more light.
- ☐ Watch the light sensor numbers as they increase. When the light sensor number is greater than the number you typed in, LEGO DACTA Control Lab turns on the lamp.
- ☐ Turn off the lamp by typing `off` in the Command Center and pressing Return or Enter.
- ☐ Click on the File menu and select Quit to shut down the Control Lab software. Click "No" at the dialog box asking if you want to save the project.

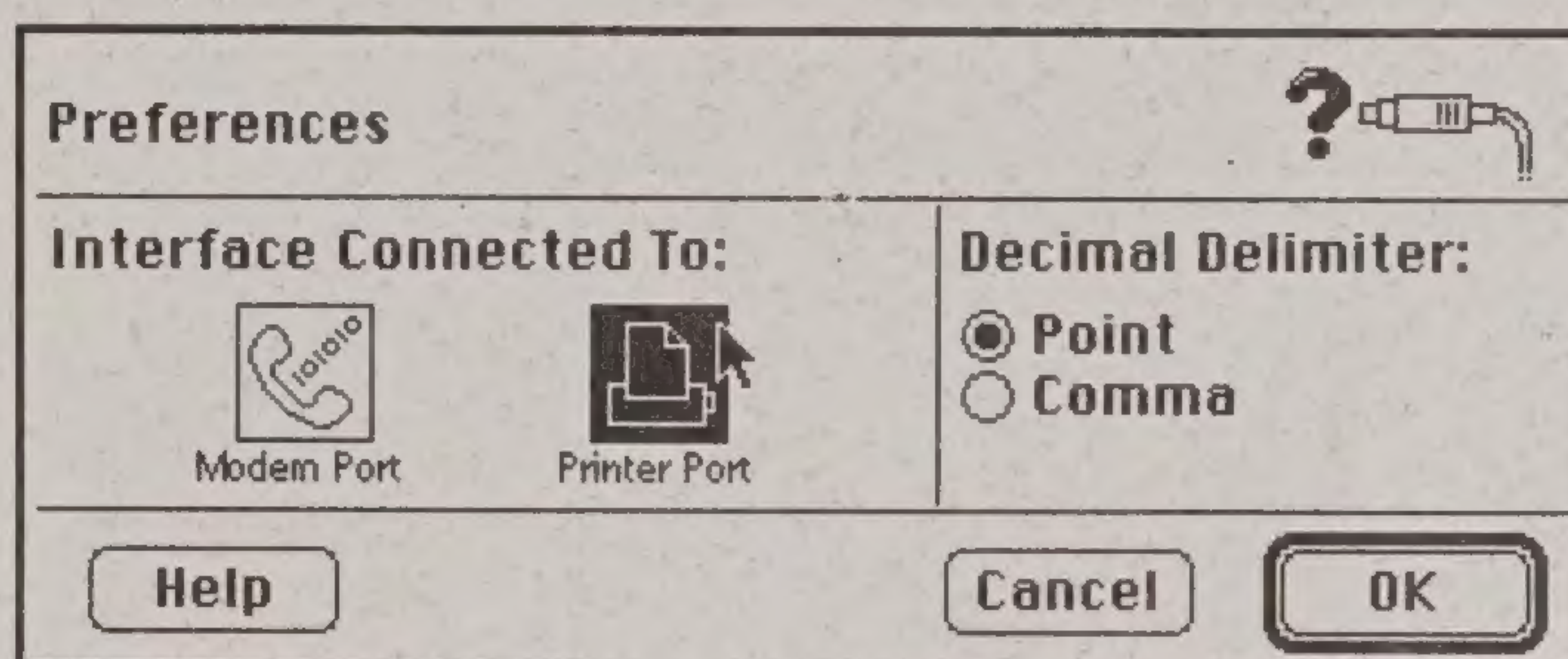
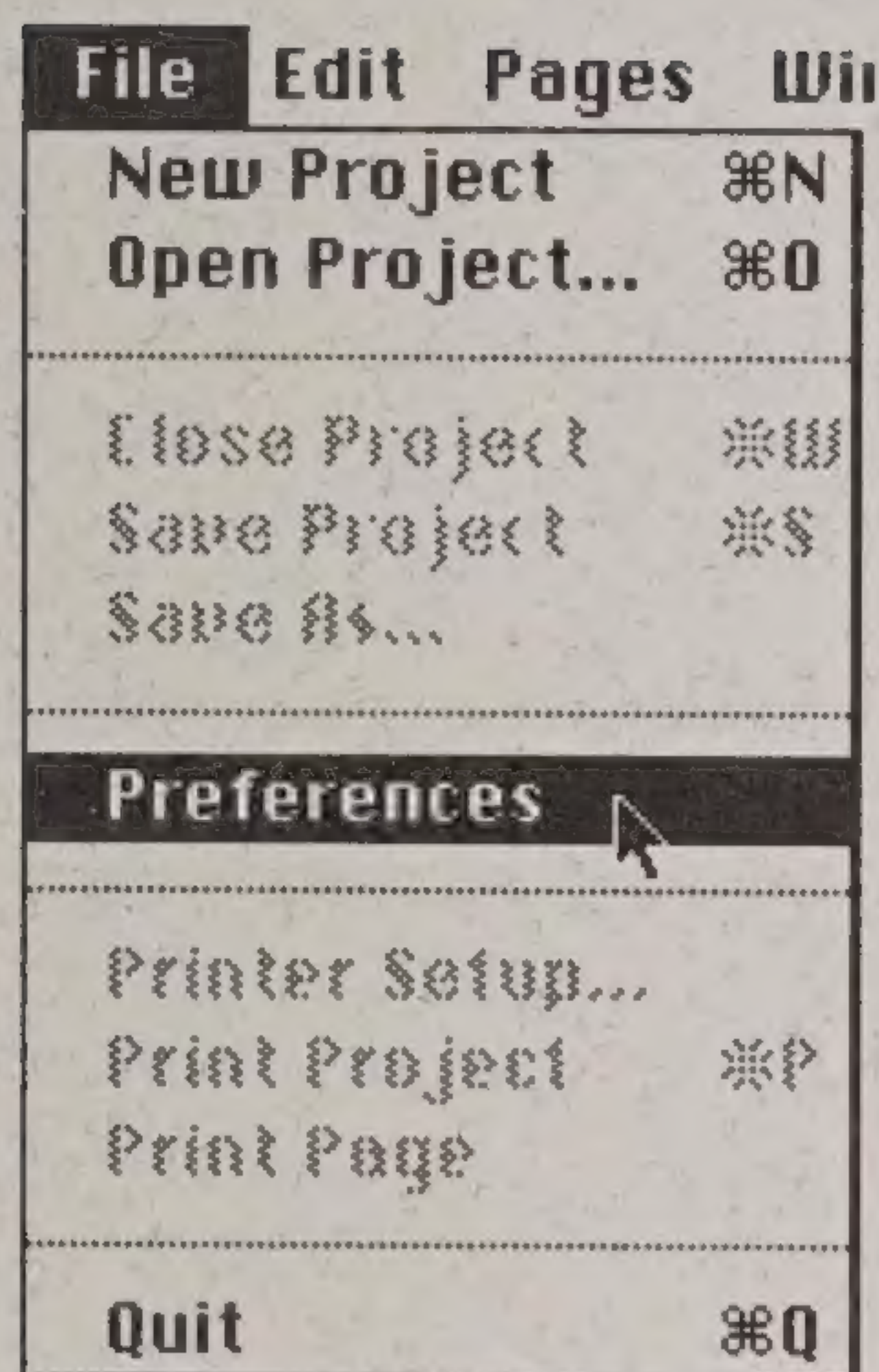


# Troubleshooting Help

If you see the error message “Can’t find the Control Lab interface box.” while trying to load the software, it may mean that the LEGO DACTA® Serial Interface and transformer are not connected properly. Turn the computer off and check the connections. Review the connection steps on page 3. Then turn the computer back on and try starting the LEGO DACTA Control Lab software once more.

**Macintosh users:** If you attached the cable to the printer port instead of the modem port, select Preferences from the Control Lab File menu.

Click on the printer port icon to change the setting of the dialog box from Modem to Printer, and then click OK.



**MS-DOS users:** If you attached the cable to COM2 instead of COM1, select Preferences from the Control Lab File menu. Click on COM2 to change the setting of the dialog box from COM1 to COM2. Then click OK.

## Here is a brief troubleshooting chart to follow if necessary.

Computer Message	Action To Take
Can't find the interface box	<p>Make sure the cable is connected snugly to the interface box and that the other end is securely inserted in the modem or COM1 port.</p> <p>Also, make sure the transformer is plugged in and that the green “On” light on the interface box is shining.</p> <p>If this message appears while you have a project open, pull out the cable from the back of the computer and reconnect it. Then click in the Control Lab project area to see if communication is reactivated. If communication is not restored, save the project, Quit Control Lab and check the computer, cable and interface box connections again.</p>
Not enough memory	<p>Save and Quit out of any other software programs you may have running.</p> <p>Macintosh users: Quit out of Control Lab. Click to select the Control Lab icon. Select Get Info from the File menu. Change the Application Memory Size (K) to a smaller amount (cannot be less than 1024 K). Or, use a computer with more memory.</p>

### Teacher note:

If the system still does not work properly, write down any error messages and call LEGO Dacta at 800-527-8339. Ask for technical support.



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